



Designation: D4026 – 06 (Reapproved 2021)

# Standard Test Method for Rubber Latex—Styrene-Butadiene Copolymer—Determination of Residual Styrene<sup>1</sup>

This standard is issued under the fixed designation D4026; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## 1. Scope

1.1 This test method covers the determination of the residual styrene content of styrene butadiene (SBR) latex. This test method is based upon direct injection of a diluted latex into a gas chromatograph. The amount of residual styrene is calculated using an internal standard technique.

1.2 The range of residual styrene covered is approximately 100 to 3000 mg/kg (ppm) with a lower detection limit of approximately 50 mg/kg (ppm).

1.3 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.4 *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 safety statements, see Section 8.)*

1.5 *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:*<sup>2</sup>

[D4483 Practice for Evaluating Precision for Test Method Standards in the Rubber and Carbon Black Manufacturing Industries](#)

[E11 Specification for Woven Wire Test Sieve Cloth and Test Sieves](#)

<sup>1</sup> This test method is under the jurisdiction of ASTM Committee D11 on Rubber and Rubber-like Materials and is the direct responsibility of Subcommittee D11.11 on Chemical Analysis.

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

[E260 Practice for Packed Column Gas Chromatography](#)

[E355 Practice for Gas Chromatography Terms and Relationships](#)

## 3. Summary of Test Method

3.1 A sample of latex is mixed with a wetting agent and an internal standard of vinyl toluene. It is then injected into a gas chromatograph equipped with a flame ionization detector. The amount of residual styrene is determined by the internal standard technique.

## 4. Significance and Use

4.1 The amount of residual styrene (unreacted styrene) in an SBR latex must be studied from health, safety, economic, and environment viewpoints. This test method is useful in studying these aspects of residual styrene and also in research, development, and factory processing problems.

## 5. Interferences

5.1 Materials that interfere with the complete separation of styrene and vinyl toluene must be absent. Matrix effects (anything in the latex that affects the release of styrene or vinyl toluene, or both) may be minimized by the use of an addition technique.

## 6. Apparatus

6.1 *Gas Chromatograph:*

6.1.1 Any gas chromatograph whose operating parameters and columns provide well-resolved, narrow, styrene and vinyl toluene peaks, free of interference, may be used. The chromatograph must be equipped with a flame ionization detector (FID) and preferably with some means of electronic or microprocessor type of integration. Detectors must be operated in the 200 to 300°C range and injection ports must be operated in the 200 to 210°C range.

NOTE 1—It is understood that the gas chromatograph will be operated in accordance with the manufacturer's instructions for optimum performance and that the equipment will be operated by persons knowledgeable in the techniques of gas chromatography. Practice [E260](#) and Practice [E355](#), manufacturer's literature, and standard texts on gas chromatography are especially helpful.

6.1.2 Equip the chromatograph with removable glass liners for easy cleaning. *Cleaning will be required when spurious*

**TABLE 1 Parameters for the Gas Chromatograph**

NOTE 1—Packings and supports may also be obtained from most companies that supply gas chromatographic supplies and equipment.

Chromatograph	A	B	C	D	E
Column:					
Glass	X				X
Stainless steel		X	X	X	
Length, cm	300	300	300	180	150
Outside diameter, mm	6	3	3	3	6
Inside diameter, mm	2	—	—	—	2
Packed with	20 % SP 2100 <sup>A,B</sup> or OV-101/0.1 % <sup>C,B</sup> Carbowax 1500 <sup>D, B</sup>	20 % SP 2100 or OV-101/0.1 % Carbowax 1500	10 % OV 225 <sup>C,B</sup>	10 % Apiezon L <sup>E,B</sup>	5 % SP 1200/ 1.7 % Bentone 34 <sup>F,B</sup>
Support type	Supelcoport <sup>A,B</sup>	Supelcoport	(1) Chromosorb W-HP <sup>G,B</sup> (2) Chromosorb P-NAW <sup>G,B</sup>	Chromosorb W	Supelcoport
Mesh size, $\mu\text{m}^H$	150/125	150/125	(1) 150/125 (2) 180/150	180/150	125
Carrier gas	helium	helium	helium	helium	helium
Carrier gas flow, $\text{cm}^3/\text{min}$	30	30	15	30	—
Detector, $^{\circ}\text{C}$	250	250	250	200	300
Program:					
Initial, $^{\circ}\text{C}$	80–90	80–90		50	85
Initial time, min	5	5		2	19
Rate, $^{\circ}\text{C}$	8	8		16	50
Final, $^{\circ}\text{C}$	120	120	135	150	165
Isothermal	No	No	Yes	No	No

<sup>A</sup> The sole source of supply of the apparatus (SP 2100 and Supelcoport) known to the committee at this time is Supelco, Inc., Supelco Park, Bellefonte, PA 16823.  
<sup>B</sup> 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,<sup>1</sup> which you may attend.  
<sup>C</sup> The sole source of supply of the apparatus (OV-101 and 225) known to the committee at this time is Pierce Chemical Co., P.O. Box 117, Rockford, IL 61105.  
<sup>D</sup> The sole source of supply of the apparatus (Carbowax 1500) known to the committee at this time is Union Carbide Corp., 270 Park Ave., New York, NY 10017.  
<sup>E</sup> The sole source of supply of the apparatus (Apiezon L) known to the committee at this time is the James G. Biddle Co., Township Line & Jolly Rds., Plymouth Meeting, PA 19462.  
<sup>F</sup> The sole source of supply of the apparatus (Bentone 34) known to the committee at this time is the National Lead Co., Baroid Div., Box 1675, Houston, TX 77001.  
<sup>G</sup> The sole source of supply of the apparatus (Chromosorb P-NAW and W-HP) known to the committee at this time is Johns-Mansville, 22 E. 40 St., New York, NY 10016.  
<sup>H</sup> Specification E11; Sieve designations: No. 80 180 $\mu\text{m}$ , No. 100 150  $\mu\text{m}$ , No. 120 125  $\mu\text{m}$ .

peaks begin to appear and usually after about 20 injections. If glass liners are not available, metal liners, packed with glass wool, may be used.

**6.2 Gas Chromatographic Columns, Packings, and Programs**—Any column, packing, or program listed in Table 1 is satisfactory, as long as it produces narrow, well-resolved styrene and vinyl toluene peaks. Other columns, packings, and programs may be used, as long as they satisfy these requirements.

**6.3 Syringes**, capable of delivering 1  $\text{mm}^3$  (1 $\mu\text{L}$ ).

NOTE 2—Syringes may be cleaned by drawing water into the syringe barrel, then ejecting it, while heating the syringe needle with a small flame.

**6.4 Pipets**, capable of accurately delivering 0.1  $\text{cm}^3$ .

**6.5 Glass Vials**, of 20- $\text{cm}^3$  capacity, equipped with self-sealing septa.

**6.6 Analytical Balance**, capable of weighing to  $\pm 0.1$  mg.

**6.7 Ordinary Laboratory Glassware**, necessary for carrying out this procedure.

**6.8 Mechanical Shaker**, that will accept the vials of 6.5. (Desirable, but not mandatory.)

## 7. Reagents and Materials

**7.1 Deionized Water** or equivalent.

**7.2 Nonionic Wetting Agent** (isooctyl phenyl polyethoxy ethanol).<sup>3</sup>

**7.3 Styrene** (*p*-tert butyl catechol, inhibited)—There shall be no chromatographic peaks that interfere with vinyl toluene and it shall show no turbidity when mixed with methanol.

**7.4 Vinyl Toluene** (polymerization grade—28 % *p*-vinyl toluene and 72 % *m*-vinyl toluene) and pure *o*-vinyl toluene. Both chemicals elute from the chromatograph as one sharp peak and have the same response to the FID. Neither of these chemicals shall show turbidity when mixed with methanol.

## 8. Safety Precautions

8.1 Special care should be exercised in the use of compressed gases required for the operation of the gas chromatograph. Styrene and vinyl toluene should be handled in well-ventilated areas or in fume hoods, to minimize health and safety hazards.

## 9. Sampling and Selection of Test Portions

9.1 Since the use of this test method may be required for any purpose listed under Section 4, the analyst may choose the

<sup>3</sup> The sole source of supply of nonionic wetting agent (Triton X100) known to the committee at this time is Rohm and Haas, Philadelphia, PA 19105. 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,<sup>1</sup> which you may attend.