

abrasion coefficient of not less than 20 liters per mil of film thickness.

[42 FR 14572, Mar. 15, 1977, as amended at 46 FR 57033, Nov. 20, 1981; 49 FR 10110, Mar. 19, 1984; 50 FR 51847, Dec. 20, 1985; 56 FR 15278, Apr. 16, 1991; 56 FR 42933, Aug. 30, 1991]

**§ 177.1810 Styrene block polymers.**

The styrene block polymers identified in paragraph (a) of this section may be safely used as articles or as components of articles intended for use in contact with food, subject to provisions of this section.

(a) For the purpose of this section, styrene block polymers are basic polymers manufactured as described in this paragraph, so that the finished polymers meet the specifications prescribed

in paragraph (b) of this section, when tested by the methods described in paragraph (c) of this section.

(1) Styrene block polymers with 1,3-butadiene are those produced by the catalytic solution polymerization of styrene and 1,3-butadiene.

(2) Styrene block polymers with 2-methyl-1,3-butadiene are those produced by the catalytic solution polymerization of styrene and 2-methyl-1,3-butadiene.

(3) Styrene block polymers with 1,3-butadiene, hydrogenated are those produced by the catalytic solution polymerization of styrene and 1,3-butadiene, and subsequently hydrogenated.

(b) *Specifications:*

Styrene block polymers	Molecular weight (minimum)	Solubility	Glass transition points	Maximum extractable fraction in distilled water at specified temperatures, times, and thicknesses	Maximum extractable fraction in 50 percent ethanol at specified temperatures, times, and thicknesses
1. (i) Styrene block polymers with 1,3-butadiene; for use as articles or as components of articles that contact food of Types I, II, IV-B, VI, VII-B, and VIII identified in table 1 in § 176.170(c) of this chapter under conditions of use D, E, F, and G described in table 2 in § 176.170(c) of this chapter.	29,000	Completely soluble in toluene.	-98 °C (-144 °F) to -71 °C (-96 °F) and 86 °C (187 °F) to 122 °C (252 °F).	0.0039 mg/cm <sup>2</sup> (0.025 mg/in <sup>2</sup> ) of surface at reflux temperature for 30 min on a 0.19 cm (0.075 in) thick sample.	0.002 mg/cm <sup>2</sup> (0.01 mg/in <sup>2</sup> ) of surface at 66 °C (150 °F) for 2 hr on a 0.19 cm (0.075 in) thick sample.
(ii) Styrene block polymers with 1,3-butadiene; for use as components of pressure-sensitive adhesives that contact food of Types I, II, IV-B, VI, VII-B, and VIII identified in table 1 in § 176.170(c) of this chapter under conditions of use C, D, E, F and G described in table 2 in § 176.170(c) of this chapter, provided the pressure-sensitive adhesives be applied only to closure tapes for sealing containers having a capacity of not less than 160 cc (5.5 fluid ounces) and that the area of the adhesive exposed to food shall not exceed 4.03 cm <sup>2</sup> (0.625 in <sup>2</sup> ). The pressure-sensitive adhesive may contain terpene resins as identified in § 175.125(b)(2) of this chapter.	29,000	.....do .....	.....do .....	.....do .....	Do.
2. Styrene block polymers with 2-methyl-1,3-butadiene; for use as articles or as components of articles that contact food of Types I, II, IV-B, VI, VII-B, and VIII identified in table 1 in § 176.170(c) of this chapter.	29,000	.....do .....	-65 °C (-85 °F) to -47 °C (-53 °F) and 86 °C (187 °F) to 122 °C (252 °F).	0.002 mg/cm <sup>2</sup> (0.01 mg/in <sup>2</sup> ) of surface at reflux temperature for 2 hr on a 0.071 cm (0.028 in) thick sample. (Optionally, maximum net residue soluble in chloroform shall not exceed 0.00020 mg/cm <sup>2</sup> (0.0013 mg/in <sup>2</sup> ) of surface.)	0.002 mg/cm <sup>2</sup> (0.01 mg/in <sup>2</sup> ) of surface at 66 °C (150 °F) for 2 hr on a 0.071 cm (0.028 in) thick sample. (Optionally, maximum net residue soluble in chloroform shall not exceed 0.00040 mg/cm <sup>2</sup> (0.0025 mg/in <sup>2</sup> ) of surface.)

Styrene block polymers	Molecular weight (minimum)	Solubility	Glass transition points	Maximum extractable fraction in distilled water at specified temperatures, times, and thicknesses	Maximum extractable fraction in 50 percent ethanol at specified temperatures, times, and thicknesses
3. (i) Styrene block polymers with 1,3-butadiene, hydrogenated (CAS Reg. No. 66070–58–4): for use as articles or as components of articles that contact food of Types I, II, IV–B, VI, VII–B, and VIII identified in table 1 in § 176.170(c) of this chapter.	16,000	.....do .....	-50 °C (-58 °F) to -30 °C (-22 °F) and 92 °C (198 °F) to 98 °C (208 °F).	0.002 mg/cm <sup>2</sup> (0.01 mg/in <sup>2</sup> ) of surface at reflux temperature for 2 hr on a 0.071 cm (0.028 in) thick sample.	0.002 mg/cm <sup>2</sup> (0.01 mg/in <sup>2</sup> ) of surface at 66 °C (150 °F) for 2 hr on a 0.071 cm (0.028 in) thick sample.
(ii) Styrene block polymers with 1,3-butadiene, hydrogenated (CAS Reg. No. 66070–58–4): for use at levels not to exceed 42.4 percent by weight as a component of closures with sealing gaskets that would contact food of Types III, IV–A, V, VII–A, VIII, and IX identified in table 1 in § 176.170(c) of this chapter, and in condition of use D as described under table 2 in § 176.170(c) of this chapter.	16,000	.....do .....	.....do .....	.....do .....	Do.

(c) The analytical methods for determining whether styrene block polymers conform to the specifications prescribed in this section are as follows and are applicable to the finished polymer.

(1) *Molecular weight.* Molecular weight shall be determined by intrinsic viscosity (or other suitable method).

(2) *Glass transition points.* The glass transition points shall be determined by either of the following methods:

(i) ASTM method D2236-70 ("Standard Method of Test for Dynamic Mechanical Properties of Plastics by Means of Torsional Pendulum," which is incorporated by reference; copies are available from American Society for Testing and Materials (ASTM), 1916 Race Street, Philadelphia, PA 19103, or available for inspection at the Office of the Federal Register, 800 North Capitol Street, NW., suite 700, Washington, DC 20408) modified by using a forced resonant vibration instead of a fixed vibration and by using frequencies of 25 to 40 cycles per second instead of 0.1 to 10 cycles per second.

(ii) Direct reading viscoelastometric method titled "Direct Reading Viscoelastometric Method for Determining Glass Transition Points of Styrene Block Polymers" (which is incorporated by reference; copies are available from the Center for Food Safety and Applied Nutrition (HFS-200), Food and Drug Administration, 200 C St.

SW., Washington, DC 20204, or available for inspection at the Office of the Federal Register, 800 North Capitol Street, NW., suite 700, Washington, DC 20408), by which the glass transition points are determined in the tensile mode of deformation at a frequency of 35 hertz using a Rheovibron Model DDV-II (or equivalent) Direct Reading Viscoelastometer. Take maxima in the out-of-phase component of the complex modulus as the glass transition points. For block polymers of low styrene content or for simple block polymers, the polymer may be treated with 0.3 part per hundred dicumyl peroxide and cured for 30 minutes at 153 °C to accentuate the upper transition point.

(3) *Maximum extractable fractions in distilled water and 50 percent ethanol and the maximum net residue solubles in chloroform.* The maximum extractable fractions in distilled water and 50 percent ethanol, and the maximum net residue solubles in chloroform, shall be determined in accordance with § 176.170(d)(3) of this chapter using a sandwich form of the finished copolymer of the specified thickness and for the time and temperature specified in paragraph (b) of this section.

(d) The provisions of this section are not applicable to butadiene-styrene copolymers listed in other sections of this subpart.

(e) The provisions of this section are not applicable to styrene block polymers with 1,3-butadiene listed in § 175.105 of this chapter.

[42 FR 14572, Mar. 15, 1977, as amended at 42 FR 43621, Aug. 30, 1977; 47 FR 11844, Mar. 19, 1982; 51 FR 16828, May 7, 1986; 54 FR 24898, June 12, 1989; 58 FR 65546, Dec. 15, 1993]

**§ 177.1820 Styrene-maleic anhydride copolymers.**

Styrene-maleic anhydride copolymers identified in paragraph (a) of this section may be safely used as articles

or components of articles intended for use in contact with food, subject to provisions of this section.

(a) For the purpose of this section, styrene-maleic anhydride copolymers are those produced by the polymerization of styrene and maleic anhydride so that the finished polymers meet the specifications prescribed in paragraph (b) of this section, when tested by the methods described in paragraph (c) of this section.

(b) *Specifications:*

Styrene-maleic copolymers	Molecular weight (minimum number average)	Residual styrene monomer	Residual maleic anhydride monomer	Maximum extractable fraction in distilled water at specified temperatures, times, and particle size	Maximum extractable fraction in n-heptane at specified temperatures, times, and particle size
1. Styrene-maleic anhydride copolymers containing not more than 15 pct maleic anhydride units by weight; for use as articles or as components of articles that contact food of Types I, II, III, IV-A, IV-B, V, VI-B (except carbonated beverages), VII-A, VII-B, VIII, and IX identified in table 1 in § 176.170(c) of this chapter under conditions of use B, C, D, E, F, G, and H described in table 2 in § 176.170(c) of this chapter.	70,000	0.3 weight percent.	0.1 weight percent.	0.006 weight percent at reflux temperature for 1 hr utilizing particles of a size that will pass through a U.S. standard sieve No. 10 and will be held on a U.S. standard sieve No. 20.	0.02 weight percent at 73 °F for 2 hr utilizing particles of a size that will pass through a U.S. standard sieve No. 10 and will be held on a U.S. standard sieve No. 20.
2. Styrene-maleic anhydride copolymer modified with butadiene, (CAS Reg. No. 27288-99-9) containing not more than 15 percent maleic anhydride units by weight and not more than 20 percent styrene-butadiene and/or butadiene rubber units by weight; for use (except carbonated beverage bottles) as articles or as components of articles that contact food of Types I, II, III, IV-A, IV-B, V, VI, VII-A, VII-B, VIII, and IX identified in table 1 in § 176.170(c) of this chapter under conditions of use B, C, D, E, F, G, and H described in table 2 in § 176.170(c) of this chapter.	.....	0.3 .....	0.1 .....	0.015 weight percent at reflux temperature for 1 hour utilizing particles of a size that will pass through a U.S. standard sieve No. 10 and will be held on a U.S. standard sieve No. 20.	1.0 weight percent at 23 °C (73 °F) for 2 hours utilizing particles of a size that will pass through a U.S. standard sieve No. 10 and will be held on a U.S. standard sieve No. 20.

(c) The analytical methods for determining conformance with specifications for styrene-maleic anhydride copolymers prescribed in this section are as follows:

(1) *Molecular weight.* Molecular weight shall be determined by membrane osmometry.

(2) *Residual styrene monomer content.* Residual styrene monomer content shall be determined by the method described in § 177.1640(d).

(3) *Residual maleic anhydride monomer content.* Residual maleic anhydride monomer content shall be determined

by a gas chromatographic method titled "Determination of Residual Maleic Anhydride in Polymers by Gas Chromatography," which is incorporated by reference. Copies are available from the Center for Food Safety and Applied Nutrition (HFS-200), Food and Drug Administration, 200 C St. SW., Washington, DC 20204, or available for inspection at the Office of the Federal Register, 800 North Capitol Street, NW., suite 700, Washington, DC 20408.