



Designation: D 3185 – 99

Standard Test Methods for Rubber—Evaluation of SBR (Styrene-Butadiene Rubber) Including Mixtures With Oil¹

This standard is issued under the fixed designation D 3185; 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 These test methods cover the standard materials, test formulas, mixing procedures, and test methods for the evaluation of emulsion polybutadiene (EBR) and styrene-butadiene rubbers (SBR) including the emulsion polybutadiene oil masterbatch rubbers, SBR oil masterbatches, and partially crosslinked and high Mooney rubbers.

1.2 These test methods are also applicable to certain types of solution SBR and solution SBR oil masterbatches that are used in applications requiring vulcanization.

1.3 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

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

2. Referenced Documents

2.1 ASTM Standards:

- D 412 Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers—Tension²
- D 1646 Test Method for Rubber—Viscosity, Stress Relaxation, and Pre-Vulcanization Characteristics (Mooney Viscometer)²
- D 2084 Test Method for Rubber Property—Vulcanization Using Oscillating Disk Cure Meter²
- D 3182 Practice for Rubber—Materials, Equipment, and Procedures for Mixing Standard Compounds and Preparing Standard Vulcanized Sheets²
- D 3896 Practice for Rubber from Synthetic Sources—Sampling²
- D 4483 Practice for Determining Precision for Test Method Standards in the Rubber and Carbon Black Industries²

2.2 ISO Standard:

ISO 2322 Rubber, Styrene-Butadiene (SBR)—Emulsion-Polymerized General-Purpose Type—Test Recipe and Evaluation of Vulcanization Characteristics³

3. Summary of Test Methods

3.1 These test methods include the standard test formulas, mixing procedures, and test methods for evaluating the following types of synthetic rubbers:

3.1.1 *Non-Oil-Extended Types*, mill and Miniature Internal Mixer (MIM) mixing procedures.

3.1.2 *Oil Masterbatch Types*, mill and Miniature Internal Mixer (MIM) mixing procedures.

3.2 No correlation between results for mill and MIM mixing procedures is implied.

4. Significance and Use

4.1 These test methods are mainly intended for referee purposes but may be used for quality control of synthetic rubber production. They may also be used in research and development work and for comparison of different rubber samples in a standard formula.

4.2 These test methods may also be used to obtain values for customer acceptance of rubber.

5. Standard Test Formulas

5.1 Standard Formulas for Non-Oil-Extended Types:

Material	IRM-SRM No.	Quantity, Parts by Mass	
		1A	2A
SBR or masterbatch	...	100.00	100.00
Zinc oxide	A	3.00	3.00
Sulfur	A	1.75	1.75
Stearic acid	A	1.00	1.00
Oil furnace black ^B	A	50.00	35.00
TBBS ^C	A	1.00	1.00
Total		156.75	141.75
Batch factor for mill mix ^D		3.0	3.3
Batch factor for MIM mix ^E :			
Cam head		0.47	0.49
Banbury head		0.41	0.46

^AUse Current IRM/SRM.

^BThe current Industry Reference Black (IRB) which has been dried for 1 h at

³ Available from American National Standards Institute, 11 W. 42nd St., 13th Floor, New York, NY 10036.

¹ These test methods are under the jurisdiction of ASTM Committee D-11 on Rubber and are the direct responsibility of Subcommittee D11.23 on Synthetic Rubbers.

Current edition approved May 10, 1999. Published June 1999. Originally published as D 3185 – 73. Last previous edition D 3185 – 88 (1994).

² Annual Book of ASTM Standards, Vol 09.01.

125 ± 3°C (257 ± 5°F) may be used in place of NBS 378, although slightly different results may be obtained.

^C*N-tert-butyl-2-benzothiazolesulfenamide.*

^DFor mill batches, weigh the rubber and carbon black to the nearest 1.0 g, the sulfur and accelerator to the nearest 0.02 g, and the other compounding materials to the nearest 0.1 g.

^EFor MIM batches, weigh the rubber and carbon black to the nearest 0.1 g, the compounding material blend to the nearest 0.01 g, and the individual compounding materials, if used, to the nearest 0.001 g.

5.1.1 For the MIM procedure it is recommended that a blend of compounding materials, excluding carbon black, be prepared to improve accuracy in the weighing of these materials. The compounding material blend is prepared by blending a proportional mass of each material in a dry powder blender such as a biconical blender or vee blender. A mortar and pestle may be used for blending small quantities.

5.1.2 Formula 1A shall apply to the general-purpose non-pigmented, non-oil-extended rubber types. It is also specified in International Standard ISO 2322 for evaluation of general purpose, nonpigmented, non-oil-extended rubbers. Formula 2A

shall apply to the partially crosslinked and high-Mooney rubber (>90 ML 1 + 4 at 100°C) for example, SBR 1009, 1018, and 1012 types.

5.2 Standard Formulas for Oil Masterbatch Types:

5.2.1 Formulas 1B to 6B shall apply to the general purpose nonpigmented oil-extended rubber types according to the oil content of the rubber. Formula 1A may be used as an alternative to Formulas 1B to 6B. International Standard ISO 2322 specifies Formula 1A for evaluation of general purpose, nonpigmented, oil-extended SBR.

5.2.2 For the MIM procedure it is recommended that a blend of compounding materials, excluding carbon black, be prepared to improve accuracy in the weighing of these materials. The pigment blend is prepared by blending a proportional mass of each material in a dry powder blender such as a biconical blender or vee blender. A mortar and pestle may be used for blending small quantities.

Material Formula No. Parts Oil	IRM- SRM No.	Quantity, Parts by Mass					
		1B 25	2B 37.5	3B 50	4B 62.5	5B 75	6B Base
Masterbatch		125.00	137.50	150.00	162.50	175.00	100 + Y ^A
Zinc oxide	^B	3.00	3.00	3.00	3.00	3.00	3.00
Sulfur	^B	1.75	1.75	1.75	1.75	1.75	1.75
Stearic acid	^B	1.00	1.00	1.00	1.00	1.00	1.00
Oil furnace black ^C	^B	62.50	68.75	75.00	81.25	87.50	50 (100 + Y)0.01
TBBS ^D	384	1.25	1.38	1.50	1.63	1.75	1 1 (100 + Y)0.01 1
Total		194.50	213.38	232.25	251.13	270.00	
Batch factor for mill mix ^E		2.4	2.2	2.0	1.9	1.7	
Batch factor for MIM mix:							
Cam head ^D		0.37	0.34	0.31	0.29	0.27	
Banbury head ^F		0.328	0.298	0.273	0.252	0.234	

^A Y = parts oil by mass per 100 parts base polymer in masterbatch.

^B Use Current IRM/SRM.

^C The current Industry Reference Black (IRB) which has been dried for 1 h at 125 ± 3°C (257 ± 5°F) may be used in place of NBS 378, although slightly different results may be obtained.

^D *N-tert-butyl-2-benzothiazolesulfenamide.*

^E For mill batches, weigh the rubber and carbon black to the nearest 1.0 g, the sulfur and accelerator to the nearest 0.02 g, and the other compounding materials to the nearest 0.1 g.

^F For MIM batches, weigh the rubber and carbon black to the nearest 0.1 g, the compounding material blend to the nearest 0.01 g and the individual compounding materials, if used, to the nearest 0.001 g.

6. Sample Preparation

6.1 Obtain the test samples in accordance with Practice D 3896.

7. Mixing Procedures

7.1 Two mixing procedures are provided:

7.1.1 *Method A*—Mill mix (7.2).

7.1.2 *Method B*—Miniature internal mixer (MIM) mix (7.3).

NOTE 1—It is not implied that comparable results will be obtained by these test methods.

7.2 *Method A—Mill Mix Procedure:*

7.2.1 For general mixing procedures refer to Practice D 3182.

7.2.2 Mix with the mill roll temperature maintained at 50 ± 5°C (122 ± 9°F). The indicated mill openings are desired and should be maintained insofar as possible to provide uniformity in the breakdown of the rubber due to milling.

7.2.3 Mixing Cycle:

	Duration, min	Accu- mula- tive, min
7.2.3.1		
Set the mill opening at 1.15 mm (0.045 in.) and band the rubber on the slow roll. Make ¾ cuts every ½min from alternate sides.	7	7
7.2.3.2		
Add the sulfur slowly and evenly across the mill at a uniform rate.	2	9