Designation: D3190 – 06 (Reapproved 2021)

Standard Test Method for Rubber—Evaluation of Chloroprene Rubber (CR)[1]

This standard is issued under the fixed designation D3190; 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 covers the standard materials, test formulas, mixing procedures and test methods for evaluation and quality control testing of chloroprene rubbers (CR). CR can be generally classified according to the two types of polymerization modifiers used in their manufacture: sulfur modified types and mercaptan modified types.

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

1.3 *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.*

1.4 *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]

D412 Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension

D1646 Test Methods for Rubber—Viscosity, Stress Relaxation, and Pre-Vulcanization Characteristics (Mooney Viscometer)

D2084 Test Method for Rubber Property—Vulcanization Using Oscillating Disk Cure Meter

D3182 Practice for Rubber—Materials, Equipment, and Procedures for Mixing Standard Compounds and Preparing Standard Vulcanized Sheets

D3896 Practice for Rubber From Synthetic Sources—Sampling

D4483 Practice for Evaluating Precision for Test Method Standards in the Rubber and Carbon Black Manufacturing Industries

D5289 Test Method for Rubber Property—Vulcanization Using Rotorless Cure Meters

D6204 Test Method for Rubber—Measurement of Unvulcanized Rheological Properties Using Rotorless Shear Rheometers

3. Summary of Test Method

3.1 Separate standard gum or carbon black filled formulations, or both, using different samples of CR, are prepared on a laboratory mill or in a Miniature Internal Mixer (MIM) in accordance with Practice D3182.

3.2 See Test Method D1646 for Mooney scorch times and Test Method D2084 or D5289 for cure meter data of the formulations.

3.3 Tensile sheets for stress/strain testing are vulcanized in accordance with Practice D3182 and 100 and 300 % modulus, tensile strength and elongation at break are measured in accordance with Test Method D412.

4. Significance and Use

4.1 This test method is intended for referee purposes, but may be used for quality control, research and development testing and comparison of different rubber samples in a standard formula.

4.2 This test method may also be used to obtain values for customer acceptance of rubber.

4.3 This test method is a revision of Test Methods D3190 (prior to 1991), with 3-methyl thiazolidine thione-2 being substituted for ethylene thiourea (ETU), a suspected carcinogen.

5. Standard Test Formulae

5.1 The Standard Test Formulae are shown in Table 1. Formulae Nos. 1 and 2 shall be used for sulfur modified CR and Nos. 3 and 4 for mercaptan modified CR.

6. Sample Preparation

6.1 Obtain and prepare the test samples in accordance with Practice D3896.

[1] This test method is under the jurisdiction of ASTM Committee D11 on Rubber and Rubber-like Materials and is the direct responsibility of Subcommittee D11.23 on Synthetic Rubbers.

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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.

TABLE 1 Standard Test Formulae

Formula	1	2	3	4
Chloroprene rubber				
Sulfur modified	100.00	100.00	...	...
Mercaptan modified	...	...	100.00	100.00
Stearic acid, SRM 372[A,B]	0.50	0.50	...	...
Magnesium oxide[A,B,C]	4.00	4.00	4.00	4.00
IRB No. 6	...	25.00	...	25.00
Zinc oxide, IRM 91[A,B]	5.00	5.00	5.00	5.00
3-methyl thiazolidine thione-2-80 % in polymeric binder[D] (curative)	...	...	0.45	0.45
Total	109.50	134.50	109.45	134.45
Batch factors[E]				
Laboratory mill	3.00	3.00	3.00	3.00
MIM (Cam Head)	0.76	0.63	0.76	0.63
MIM (Banbury Head)	0.65	0.54	0.65	0.54

[A] For the MIM procedure it is recommended that a blend of the identified ingredients be prepared to improve accuracy in the weighing. The blend is made by mixing a proportional mass of each material in a dry powder blender (see Practice D3182). A mortar and pestle may be used for small quantities.
[B] Use current IRM/SRM.
[C] Maglite D, available from Marine Magnesium Company, 995 Beaver Grade Rd., Coraopolis, PA 15061.
[D] Rhenogran MTT 80, available from Rhein Chemie Corporation, 1008 Whitehead Rd. Ext., Trenton, NJ 08638 or Rhein Chemie Rheinau GmbH, Mülheimer Str. 24–28, D6800 Mannheim 81, Germany.
[E] For mill mixes, weigh the rubber and carbon black to the nearest 1.0 g, ingredients identified with footnote [A] to the nearest 0.1 g, and the curative[C] to the nearest 0.001 g. For MIM mixes weigh the rubber, carbon black and ingredient blend to the nearest 0.1 g, individual ingredients, if used, to the nearest 0.01 g and the curative[C] to the nearest 0.001 g. Note that the curative tolerances given are lower than those specified in the referenced Practice D3182.

TABLE 2 Method A—Mill Mix Cycle for Formulae 1 and 2

Maintain roll temperatures at 50 ± 5°C (122 ± 9°F).	Duration, min Gum	Black
Set the mill opening at about 1.5 mm (0.060 in.), band 300 g of rubber prepared in 7.2 and maintain a rolling bank.	1	1
Add stearic acid.	1	1
Add magnesium oxide slowly, spreading it evenly over the entire width of the band. Ensure complete addition before adding the next material.	2	2
Add carbon black. Open the mill at intervals to maintain a rolling bank.	...	5
Add zinc oxide.	2	2
Make three three-quarter cuts from alternate sides and cut stock from the mill.	2	2
Set the rolls at 0.8 mm (0.032 in.). Pass the rolled stock endwise through the mill six times.	2	2
Open the mill to give a minium stock thickness of 6 mm (0.25 in.) and pass the stock through the rolls four times, folding it back on itself.	0	0
Total time	10	15

7. Mixing Procedure

7.1 The following three mixing procedures are offered:

7.1.1 *Mill Method A*—For Formulae Nos. 1 and 2.

7.1.2 *Mill Method B*—For Formulae Nos. 3 and 4.

7.1.3 *Miniature Internal Mixer Method*—For Formulae Nos. 1, 2, 3 and 4.

7.1.4 *Laboratory Banbury*—All Formulae

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

NOTE 2—The indicated mill openings are desired and should be maintained in so far as possible to provide a standard for breakdown of the rubber due to milling.

7.2 *Raw Rubber Preparation:*

7.2.1 With the mill roll temperature maintained at 50 ± 5°C (122 ± 9°F), set the mill opening at 1.5 mm (0.060 in.) and band 320 g of CR on the slow roll for 6 min. Adjust the mill opening to maintain a rolling bank approximately 12.5 mm (0.5 in.) in diameter.

7.2.2 Remove the rubber from the mill, allow to cool to room temperature and weigh an amount equal to 300 g prior to mixing.

7.3 *Mill Method A*—Procedure for Formulae Nos. 1 and 2 (sulfur modified CR). See Table 2.

7.3.1 For general mixing, weighing and vulcanization procedures, refer to Practice D3182.

7.3.1.1 After mixing according to Table 2, measure and record the batch mass. If it differs from the theoretical value by more than 0.5 % for the carbon black stock and by 0.3 % for the gum stock, discard the batch.

7.3.1.2 If required, cut a sample to allow testing for scorch time in accordance with Test Methods D1646. The scorch test should be performed between 1 to 2 h after mixing using a test temperature of 125 ± 1°C (257 ± 1.8°F) for a rise of 5 Mooney units above the minimum with the large rotor. If also required, cut samples from the batch to allow testing of compound viscosity and processability in accordance with Test Methods D1646 or D6204, and vulcanization characteristics in accordance with Test Methods D2084 or D5289.

7.3.1.3 If tensile stress strain tests are required, sheet off to a finished thickness of approximately 2.2 mm (0.087 in.) and condition the compound according to Practice D3182.

7.4 *Mill Method B*—Procedure for Formulae Nos. 3 and 4 (mercaptan modified CR). See Table 3.

7.4.1 For general mixing, weighing and vulcanization procedures, refer to Practice D3182.

7.4.1.1 After mixing according to Table 3, measure and record the batch mass. If it differs from the theoretical value by more than 0.5 % for the carbon black stock and by 0.3 % for the gum stock, discard the batch.

7.4.1.2 If required, cut a sample to allow testing for scorch time in accordance with Test Methods D1646. The scorch test should be performed between 1 to 2 h after mixing using a test temperature of 125 ± 1°C (257 ± 1.8°F) for a rise of 5 Mooney units above the minimum with the large rotor. If also required, cut samples from the batch to allow testing of compound viscosity and processability in accordance with Test Methods D1646 or D6204, and vulcanization characteristics in accordance with Test Methods D2084 or D5289.

7.4.1.3 If tensile stress strain tests are required, sheet off to a finished thickness of approximately 2.2 mm (0.087 in.) and condition the compound according to Practice D3182.