



Standard Test Method for Rubber Property—Effect of Aqueous Solutions with Available Chlorine and Chloramine¹

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1. Scope

1.1 This test method covers procedures for evaluating the ability of rubber and rubber-like materials to withstand the effects of aqueous solutions with available chlorine and chloramine. It is intended to compare the effects of chlorine compounds, present in potable water due to disinfection procedures, on rubber articles.

1.2 Test solutions are designed to contain chlorine compounds, including hypochlorous acid (HOCl), hypochlorite ions (OCI), and monochloramine (NH₂Cl).

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

2. Referenced Documents

2.1 *ASTM Standards:*²

- D 471 Test Method for Rubber Property—Effect of Liquids
- D 1193 Specification for Reagent Water
- D 1253 Test Method for Residual Chlorine in Water
- D 1889 Test Method for Turbidity of Water³
- D 2240 Test Method for Rubber Property—Durometer Hardness
- D 3182 Practice for Rubber—Materials, Equipment, and Procedures for Mixing Standard Compounds and Preparing Standard Vulcanized Sheets
- D 3183 Practice for Rubber—Preparation of Pieces for Test Purposes from Products

¹ This test method is under the jurisdiction of ASTM Committee D11 on Rubber and is the direct responsibility of Subcommittee D11.40 on Consumer Rubber Products.

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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³ Withdrawn. The last approved version of this historical standard is referenced on www.astm.org.

D 4483 Practice for Evaluating Precision for Test Method Standards in the Rubber and Carbon Black Manufacturing Industries

3. Terminology

3.1 The terminology of chlorine compounds used in this test method is in accordance with Test Method D 1253, Section 7.

3.2 *combined residual chlorine*—residual consisting of chlorine combined with ammonia nitrogen and nitrogenous compounds.

3.3 *free available chlorine residual*—residual consisting of hypochlorite ions (OCI) or hydrochlorous acid (HOCl), or both.

3.4 *total residual chlorine (chlorine residual)*—the amount of available chlorine-induced oxidants present in water at any specified period, subsequent to the addition of chlorine.

4. Summary of Test Method

4.1 This test method provides procedures for exposing test pieces to aqueous available chlorine and chloramine solutions under defined conditions of temperature and time.

4.2 This test method includes the following procedures:

Change in mass after immersion	Section 10
Change in volume after immersion	Section 11
Change in hardness after immersion	Section 12
Visual and turbidity rating after immersion	Section 13

4.3 The resulting deterioration is measured by changes in mass, volume, hardness, and appearance of the test piece surfaces and test liquid after immersion.

4.4 This test method also describes the preparation of the immersion liquids.

5. Significance and Use

5.1 Rubber articles, such as seals, gaskets, and membranes, may be exposed in service to chlorine compounds used in potable water as disinfectants. The exposure may be intermittent or continuous and can occur at various temperatures.

5.2 Properties of rubber articles can deteriorate as a result of exposure to water containing these chlorine compounds, affecting their performance for the intended use.

5.3 This test method attempts to simulate service conditions through controlled accelerated testing, but may not give a direct correlation with part performance under actual service

TABLE 1 Immersion Periods, h

22	670
46	1006
70	1342
166	2186
334	4366
502	

conditions. It yields comparative data on which to base judgement on expected service quality.

5.4 This test method is suitable for compliance testing, quality control, and research and development work.

6. Test Conditions

6.1 *Temperature*—Unless otherwise specified between the producer and the purchaser, the preferred test temperature shall be $70 \pm 2^\circ\text{C}$.

6.1.1 If the temperature of the testing room is other than the standard $23 \pm 2^\circ\text{C}$, the actual room temperature and any effect on the temperature of the test liquids shall be reported.

6.2 *Immersion Periods*—Unless otherwise specified, the immersion periods shall be as indicated in **Table 1**, depending on the anticipated service conditions.

6.2.1 To obtain a measure on the rate of deterioration, it is necessary to take measurements after several immersion periods. The tolerance of the immersion times shall be ± 15 min or $\pm 1\%$ of the specified time, whichever is greater.

7. Apparatus

7.1 A three-necked flask^{4,5} with a capacity of 2000 cm³ shall be mounted in an electric heating mantle^{6,5} of sufficient size and wattage to maintain the specified temperature throughout the test solution. The center neck of the flask shall be used for inserting and removing test pieces and shall be fitted with a removable glass stopper. The other two necks of the flask shall be tightly fitted with an immersion thermometer and a Graham condenser^{7,5} with continuous cooling water supply.

7.2 Test procedures utilizing continuous monitoring of test liquids and automatic addition of reagents may be used but can be expected to produce different results than those obtained by the procedures of this test method.

8. Standard Test Liquids

8.1 Standard test liquids are prepared in amber glass jars of sufficient volume to hold 1900 cm³ of the liquid.

8.2 Fresh test solutions shall be prepared on a daily basis. At no time throughout the entire test period shall test pieces be allowed to remain in the same solution for more than 48 h.

8.2.1 If the test period is to be 166 h or greater, the test solutions shall be left unchanged for one day per week.

8.3 Total residual chlorine levels of at least one freshly prepared available chlorine and monochloramine solution shall be determined weekly.

8.4 Test solutions are heated in loosely sealed amber glass jars in a suitable water bath or hot forced-air oven to $70 \pm 2^\circ\text{C}$ prior to transferring them into test vessels in accordance with **Section 9**.

8.4.1 An acceptable alternative method is the use of a glass container of sufficient volume to prepare a large batch of test solution capable of filling all test vessels with 1900 cm³ of solution each. Prior to filling the test vessels, the liquid shall be stirred and checked with an immersion thermometer to ensure that the specified test temperature has been reached throughout the batch.

8.5 *Preparation of Standard Test Liquids and Solutions:*

8.5.1 *Reagent Water*—Distilled or deionized water (Type III or purer, see **Specification D 1193**) is heated to the test temperature in a loosely sealed amber glass jar and transferred to the test vessel.

8.5.2 *Available Chlorine and Chloramine Test Solution*—A volume of 1900 cm³ of distilled or deionized water (Type III or purer, see **Specification D 1193**) is heated to the test temperature in a loosely sealed amber glass jar and 1.6 cm³ of sodium hypochlorite solution⁸ with 5 % minimum total residual chlorine^{9,5} and 12.3 cm³ of buffer solution containing potassium phosphate monobasic and sodium phosphate dibasic^{10,5} (pH 7.0) are then added, using a graduated pipette. The glass jar is conditioned for 10 ± 1 min at the specified test temperature followed by the addition of 10.4 cm³ of buffer solution containing potassium phosphate monobasic and sodium phosphate dibasic^{10,5} (pH 7.0) and 2.8 cm³ 1 N ammonium hydroxide.^{11,5} The glass jar is again conditioned at the test temperature for 10 ± 1 min and the finished solution transferred to the test vessel. Solution strength shall be 50 ppm (mg/L) of total residual chlorine determined in accordance with **Test Method D 1253**, **Section 10**. The determination of free available chlorine residual and combined available chlorine residual for informational purposes is optional.

8.5.2.1 Chloramine T shall not be used as a replacement for any of the reagents specified in the preparation of the test solutions.

8.5.2.2 Sodium hypochlorite solutions are not stable and will change their concentration in storage. It is therefore recommended to use fresh solutions or store solutions in the dark under refrigeration (about 5°C). The concentration of solutions stored for any length of time should be confirmed by determining their total residual chlorine level in accordance with **Test Method D 1253**, **Section 10**. If the concentration has

⁴ The sole source of supply of the apparatus (Catalog No. 4960-2L) known to the committee at this time is Corning, Inc., County Rd. 64, Big Flats, NY 14814.

⁵ 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.

⁶ The sole source of supply of the apparatus (Catalog No. EM-2000C) known to the committee at this time is Electrothermal, Inc., 275 Morristown Rd., Gillette, NJ 07933.

⁷ The sole source of supply of the apparatus (Catalog No. 2560-500) known to the committee at this time is Corning, Inc., County Rd. 64, Big Flats, NY 14814.

⁸ The amount of sodium hypochlorite should be verified in a test solution and adjusted to provide 50 mg/L total chlorine.

⁹ The sole source of supply of the solution (Catalog No. SS-290) known to the committee at this time is Fisher Scientific, 2000 Park Lane Drive, Pittsburgh, PA 15275.

¹⁰ The sole source of supply of the solution (Catalog No. 215353) known to the committee at this time is Hach Co., 5600 Lindburgh Drive, Loveland, CO 80538.

¹¹ The sole source of supply of the solution (Catalog No. V 044) known to the committee at this time is Mallinckrodt, Inc., Highway 68 Bypass, Paris, KY 40361.