

# Colorfastness to Ozone in the Atmosphere under Low Humidities

Developed in 1963 by AATCC Committee RA33; revised 1972, 1986, 1987; reaffirmed 1971, 1975, 1983, 1992, 2002, 2005; editorially revised 1981, 1982, 1983, 1985, 1989, 1995; editorially revised and reaffirmed 1997. Partly equivalent to ISO 105-G03.

## 1. Purpose and Scope

1.1 This test method is intended for determining the resistance of the color of textiles to the action of ozone in the atmosphere at room temperatures with relative humidities not exceeding 67%.

## 2. Principle

2.1 A test specimen and a control specimen are simultaneously exposed to ozone in an atmosphere under ambient temperatures (64-82°F) and relative humidities not exceeding 67%, until the control specimen shows a color change corresponding to that of a standard of fading. This exposure period constitutes one cycle. The cycle is repeated (1) until the specimen shows a definite color change or (2) for a prescribed number of cycles.

## 3. Terminology

3.1 colorfastness, *n.*—the resistance of a material to change in any of its color characteristics, to transfer of its colorant(s) to adjacent materials or both, as a result of the exposure of the material to any environment that might be encountered during the processing, testing, storage or use of the material.

## 4. Safety Precautions

NOTE: These safety precautions are for information purposes only. The safety precautions are ancillary to the testing procedures and are not intended to be all inclusive. It is the user's responsibility to use safe and proper techniques in handling materials in this test method. Manufacturers MUST be consulted for specific details such as material safety data sheets and other manufacturer's recommendations. All OSHA standards and rules must also be consulted and followed.

4.1 Good laboratory practices should be followed. Wear safety glasses in all laboratory areas.

4.2 Manufacturer's safety recommendations should be followed when operating laboratory testing equipment. To pro-

tect the eyes further, do not look at ozone generator while it is operating.

4.3 Ozone is a sensory irritant. The test cabinet should be vented to the outside atmosphere in accordance with the manufacturer's specifications. Ozone in even moderate concentrations is injurious to health.

4.4 Exposure to chemicals used in this procedure must be controlled at or below levels set by governmental authorities (e.g., Occupational Safety and Health Administration's [OSHA] permissible exposure limits [PEL] as found in 29 CFR 1910.1000 of January 1, 1989). In addition, the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLVs) comprised of time weighted averages (TLV-TWA), short term exposure limits (TLV-STEL) and ceiling limits (TLV-C) are recommended as a general guide for air contaminant exposure which should be met (see 12.1).

## 5. Uses and Limitations

5.1 Although this test works well for some substrates, it is not suitable for nylon carpets. For nylon carpets, refer to AATCC Method 129, Colorfastness to Ozone in the Atmosphere Under High Humidities.

## 6. Apparatus and Materials

6.1 Ozone exposure chamber for ambient temperatures and relative humidities not to exceed 67% (see 12.2).

6.2 Control Sample No. 109 for relative humidities not exceeding 67% (see 12.3, 12.5 and 12.6).

6.3 Standard of Fading No. 109 for relative humidities not exceeding 67% (see 12.4, 12.5 and 12.6).

6.4 Gray Scale for Color Change (see 12.7).

## 7. Test Specimens

7.1 Cut each test specimen at least 10.0 × 6.0 cm (4.0 × 2.375 in.). For subsequent color comparisons, keep the unexposed sample in an airtight container away from light to avoid shade change.

7.2 When a laundered or drycleaned specimen is used, the effects of ozone are based on comparisons with the color of the unexposed laundered or drycleaned specimen. To prepare specimens for testing after laundering or drycleaning, use AATCC Methods 61 and 132, respectively.

7.3 Cut a control specimen of the Control Sample at least 1.3 × 5.1 cm (0.5 × 2.0 in.).

7.4 Keep unexposed specimen in an airtight container away from light to avoid shade change.

## 8. Procedure

8.1 Suspend the test specimens and a control specimen (see 12.3 and 12.5) in the exposure chamber (see 12.2). The test apparatus should be located in a room in which the ambient air temperature is 18-28°C (64-82°F) and the relative humidity does not exceed 67%. For reference and interlab testing, conduct tests in a room or chamber with the standard atmospheric conditions of 21 ± 1°C (70 ± 2°F) and 65 ± 2% RH. Ozone should be present in concentrations which produce one cycle of fading in 1.5-6.0 h of test.

8.2 Examine the control specimen periodically until the resultant color corresponds to that of the standard of fading (see 12.4 and 12.5) when compared in daylight ranging from average to slightly bluish north sky light, or equivalent artificial light. This constitutes one cycle.

8.3 Remove those specimens which exhibit a color change at the end of one cycle. One cycle will generally produce a measureable color change in specimens which are ozone sensitive.

8.4 Suspend a fresh piece of the control specimen and continue exposure of any remaining specimens for a second cycle.

8.5 Run additional similar cycles as necessary.

## 9. Evaluation

9.1 At the end of each cycle immediately compare those specimens which are removed from the exposure chamber with the preserved originals from which they were drawn.

9.2 Rate the effect on color of test specimens after any specified number of cycles by reference to the Gray Scale for Color Change, and report the number of cycles run (see 12.10).

Grade 5—negligible or no change as shown in Gray Scale Step 5.

Grade 4.5—change in color equivalent to Gray Scale Step 4-5.

Grade 4—change in color equivalent to Gray Scale Step 4.

Grade 3.5—change in color equivalent to Gray Scale Step 3-4.

Grade 3—change in color equivalent to Gray Scale Step 3.

Grade 2.5—change in color equivalent to Gray Scale Step 2-3.



Grade 2—change in color equivalent to Gray Scale Step 2.

Grade 1.5—change in color equivalent to Gray Scale Step 1-2.

Grade 1—change in color equivalent to Gray Scale Step 1.

## 10. Report

10.1 Report the numerical grade for the change in color of each test specimen, the number of cycles run and the temperature and relative humidity at which the test was performed.

## 11. Precision and Bias

11.1 **Precision.** Precision for this test method has not been established. Until a precision statement is generated for this test method, use standard statistical techniques in making any comparisons of test results for either **within-laboratory** or **between-laboratory** averages.

11.2 **Bias.** Colorfastness to ozone in the atmosphere under low humidities can be defined only in terms of a test method. There is no independent method for determining the true values. As a means of estimating these properties, the method has no known bias.

## 12. Notes

12.1 Available from Publications Office, ACGIH, Kemper Woods Center, 1330 Kemper Meadow Dr., Cincinnati OH 45240; tel: 513/742-2020.

12.2 The ozone exposure chamber for room temperatures and relative humidities not exceeding 67% consists of an ozone generator, fan, baffle system, specimen rack and housing. Any form of an ozone generator may be used to produce the required concentration; however, ultraviolet light from mercury bulb generators or from spark-gap generators should be prevented from reaching the specimen on the rack by a suitable shield.

12.2.1 One form of generator makes use of a high voltage transformer discharge through a grid or ceramic tubes. The generator is placed in front of a low velocity fan which ejects ozone through a baffle system into the exposure chamber. The specimen rack consists of individual clamps to accommodate specimens of various sizes. Equipment is available from SDL Atlas L.L.C., 1813A Associate Lane, Charlotte NC 28217; tel: 704/329-0911; fax: 704/329-0914; e-mail: info@sdlatlas.com.

12.3 The control specimen for Lot 13 for tests made at room temperatures with relative humidities not exceeding 67% consists of a filament triacetate, woven ground fabric dyed with the following formula: 0.3% C.I. Disperse Yellow 42; 0.45% C.I. Disperse Red 35; 0.36% C.I. Disperse Blue 27 and 0.36% C.I. Disperse Blue 56.

12.4 The standard of fading for Lot 13 for tests made at room temperature with relative humidities not exceeding 67% is a filament triacetate fabric dyed with the following formula: 0.36% C.I. Disperse Yellow 86; 0.30% C.I. Disperse Red 35 and 1.65% C.I. Disperse Blue 27.

12.5 The control specimen and standard of fading for tests made at room temperatures with relative humidities not exceeding 67% are available from Testfabrics Inc., P.O. Box 26, 415 Delaware St., W. Pittston PA 18643; tel: 717/603-0432; fax: 717/603-0433; e-mail: testfabric@aol.com.

12.6 Caution: Both the control specimen

and the standard of fading must be kept in airtight containers to prevent color change encountered in normal atmospheres. In addition the control fabric is also sensitive to other atmospheric contaminants such as oxides of nitrogen. Its fading rate will vary considerably at different humidities and temperatures and its use in natural or end-use testing as a measure of exposure to ozone is not recommended. The color change produced on the controls will reflect the combined effects of the atmospheric contaminants present, temperature and humidity variations and not just the effects of exposure to ozone.

12.7 The Gray Scale is available from AATCC, P.O. Box 12215, Research Triangle Park NC 27709; tel: 919/549-8141; fax: 919/549-8933; e-mail: orders@aatcc.org.

12.8 For information regarding the measurement of ozone concentrations, see the following references:

Schulze, Fernand, "Versatile Combination Ozone and Sulfur Dioxide Analyzer," *Analytical Chemistry* 38, pp 748-752, May 1966.

"Selected Methods of the Measurement of Air Pollutants," Public Health Service Publication No. 999-AP-11, May 1965. Office of Technical Information and Publications (OTIP), Springfield VA. PB 167-677.

12.9 Apparatus for measuring ozone concentration is commercially available from several manufacturers including the following: Beckman Instrument Inc., 2500 Harbor Blvd., Fullerton CA 92634; and SDL Atlas L.L.C., 1813A Associate Lane, Charlotte NC 28217; tel: 704/329-0911; fax: 704/329-0914; e-mail: info@sdlatlas.com.

12.10 An automated electronic grading system may be used as long as the system has been demonstrated to provide results that are equal to and provide equal or better repeatability and reproducibility than an experienced grader performing visual evaluation.