

Test Method for Oil Repellency: Hydrocarbon Resistance

Foreword

This test method was developed to detect the presence of a fluorochemical finish by evaluating the fabric's resistance to wetting by liquid hydrocarbons of different surface tensions.

1. Purpose and Scope

1.1 This test method is used to determine the existence of finishing compounds capable of imparting a low energy surface by evaluating the fabric's resistance to wetting.

1.2 This test method is applicable to all types of fabrics.

2. Principle

2.1 Drops of standard test liquids, consisting of a selected series of hydrocarbons (oils) with varying surface tensions, are placed on the fabric surface and observed for wetting, wicking and contact angle. The oil repellency grade is reported, which is the numerical value of the highest numbered test liquid that does not wet the fabric surface. Results are reported as a grade from 8 to 0, with 8 representing the most oil repellency and 0 representing the least oil repellency. Half-grades may be assigned. A grade of zero (0) can be assigned when the fabric fails the mineral oil test liquid.

3. Referenced Documents

NOTE: Use current versions of all publications unless otherwise specified.

3.1 AATCC TM193, Aqueous Liquid Repellency: Water/Alcohol Solution Resistance (see 13.1)

3.2 ASTM D1776, Standard Practice for Conditioning and Testing Textiles (see 13.2).

3.3 29 CFR 1910.1000, Air Contaminants (see 13.3).

4. Terminology

4.1 **grade, n.**—the number assigned to a test specimen resulting from comparison to a scale.

4.2 **oil repellency, n.**—*in textiles*, the characteristic of a fiber, yarn or fabric whereby it resists wetting by oily liquids.

4.3 **wetting, n.**—the point at which a drop of liquid loses its light reflection characteristic, i.e., when it changes to a dull, wet spot due to the absorbent propensity of textile materials.

4.4 **wicking, n.**—*in textiles*, the movement of a liquid, by capillary action, along or through a material.

5. Safety Precautions

NOTE: These safety precautions are for information purposes only. The 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.

5.1 Follow good laboratory practices. Wear safety glasses and impervious gloves when handling test liquids in all laboratory areas.

5.2 The hydrocarbons specified in this method are flammable. Keep away from heat, sparks and open flame. Use with adequate ventilation. Avoid prolonged breathing of vapor or contact with skin. Do not take internally.

5.3 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; see www.osha.gov for latest version]. 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.

6. Uses and Limitations

6.1 This test method is not intended to give an absolute measure of the resistance of the fabric to staining by all oily materials. Other factors, such as composition and viscosity of the oily substances, fabric construction, fiber type, dyes, other finishing agents, etc., also influence stain resistance. This test can, however, provide a rough index of oil stain resistance, in that generally the higher the oil repellency grade, the better resistance to staining by oily materials, especially liquid oil substances. This is particularly true when comparing various finishes for a given fabric.

7. Apparatus and Materials (see 13.4)

7.1 Dropping bottles (see 13.5).

7.2 Test liquids prepared and num-

bered according to Table I.

7.3 AATCC blotting paper (see 13.1).

7.4 Laboratory gloves (general purpose is sufficient).

8. Specimens

8.1 Test two (2) specimens of the same size from each sample (see 13.6).

8.2 Specimen size should be sufficient to allow for the complete range of test liquids to be evaluated, but shall be no smaller than 20 × 20 cm (8 × 8 in.) and no larger than 20 × 40 cm (8 × 16 in.).

9. Conditioning

9.1 Prior to testing, condition test specimens as directed in ASTM D1776. (Use conditions indicated in Table 1 for Textiles, general. Estimate conditioning time as indicated in Table 2 for the appropriate fiber content.) Lay each swatch or product, separately, on a screen or perforated shelf of a conditioning/drying rack.

10. Procedure and Evaluation

10.1 Use silicone-free equipment, benches and gloves. Use of silicone-containing products could adversely affect the oil repellency grade.

10.2 Place two pieces of blotting paper on a smooth, horizontal surface.

10.3 Place a test specimen flat over each piece of blotting paper.

10.3.1 When evaluating open weave fabrics, conduct the test on at least two layers of the fabric; otherwise, the test

Table I—Standard Test Liquids (see 13.7)

AATCC Oil Repellency Grade	Composition	Melting or Boiling Point Range	N*
0	None (does not repel mineral oil)		
1	Mineral oil	174-177°C	31.5
2	65:35 mineral oil: n-hexadecane (by volume)	N/A	N/A
3	n-hexadecane	17-18°C	27.3
4	n-tetradecane	4-6°C	26.4
5	n-dodecane	-10.5–9.0°C	24.7
6	n-decane	173-175°C	23.5
7	n-octane	124-126°C	21.4
8	n-heptane	98-99°C	19.8

*N = dynes/cm at 25°C.



liquid may wet the underlying surface, not the actual test fabric, and thereby cause confusion in the reading of the results.

10.4 Wearing clean laboratory gloves, brush the pile of napped or pile fabrics with your hand in the direction causing the pile to lay flat prior to placing the drops of the test liquid.

10.5 Beginning with the lowest-numbered test liquid (AATCC Oil Test Grade Liquid No. 1), *carefully* place small drops [approximately 5 mm (0.187 in.) in diameter or 0.05 mL volume] on each test specimen in five locations along the filling direction. Place drops approximately 4.0 cm (1.5 in.) apart (see Fig. 1). Hold the dropper tip approximately 0.6 cm (0.25 in.) from the fabric surface while

placing drops. **DO NOT TOUCH THE FABRIC WITH THE DROPPER TIP.**

10.6 Observe the drops for 30 ± 2 s, from approximately a 45° angle.

10.7 If no penetration or wetting of the fabric at the liquid-fabric interface and no wicking around the 3 of the 5 drops occur, place drops of the next higher-numbered test liquid at an adjacent site on the fabric and again observe for 30 ± 2 s.

10.8 Continue this procedure until one of the test liquids shows obvious wetting or wicking of the fabric around 3 of the 5 drops under or around the drop within 30 ± 2 s. If wetting occurs, the test is stopped, and user should proceed to grading.

10.9 Compare drops to the examples in Fig. 2 and descriptions below. Assign the corresponding letter grade (A-D) to each

drop.

Description of Fig. 2 [Grade D]—When 3 or more of the 5 drops of a test liquid applied show complete wetting.

Description of Fig. 2 [Grade C]—When 3 or more of the 5 drops of a test liquid applied show wicking with loss of contact angle.

Description of Fig. 2 [Grade B]—When 3 or more of the 5 drops of a test liquid applied show a rounded drop with partial darkening of the test specimen.

Description of Fig. 2 [Grade A]—When 3 or more of the 5 drops of a test liquid applied show a clear well rounded appearance with high contact angle.

10.10 The Oil Repellency Grade is then determined by subtracting 0.5 from the highest numbered borderline pass (3 out of 5 Grade B or higher) test liquid number. For example:

Test Liquid 5: A, A, A, B, B
Test Liquid 6: A, B, B, B, C
Test Liquid 7: B, B, B, C, C
Test Liquid 8: B, B, C, C, C

The Oil Repellency Grade for the above example would be calculated by test liquid 7 minus 0.5 equals grade **6.5**.

10.10.1 Different types of wetting may be observed depending on the finish, fiber, construction, etc.; evaluation can be difficult on certain fabrics.

10.10.2 Wetting of the fabric is normally evidenced by a darkening of the fabric at the liquid-fabric interface or wicking and/or loss of contact angle of the drop.

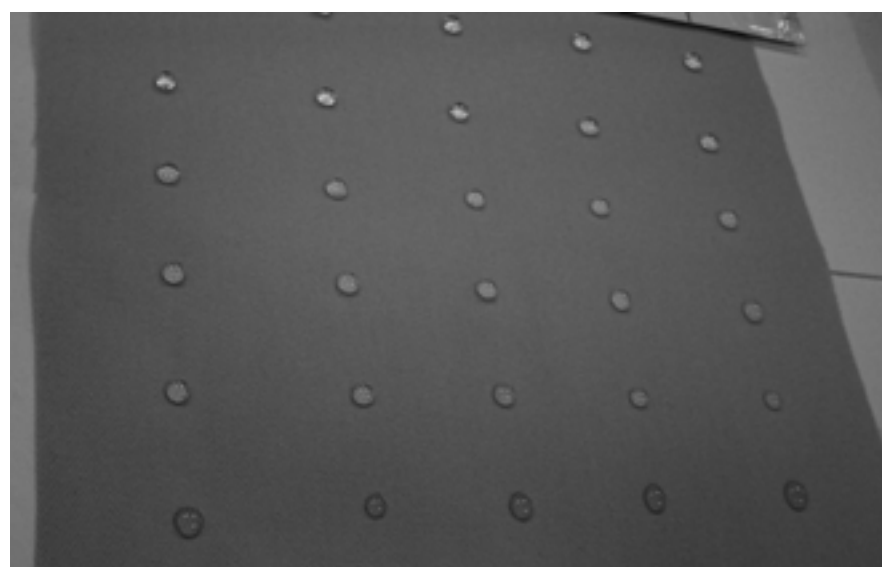
10.10.3 Many fabrics will show complete resistance to wetting by a given test liquid (Fig. 2 [A]), followed by immediate penetration by the next higher-numbered test liquid making the end point and oil repellency grade obvious. However, some fabrics will show progressive wetting under several test liquids as evidenced by a partial darkening of the fabric at the liquid-fabric interface (Fig 2 [B, C and D]). For these fabrics, the end point and oil repellency grade is the test liquid number which exhibits complete darkening of the interface or any wicking within 30 ± 2 s.

10.10.4 Wicking is the key. If the sample does not exhibit wicking but spreads (as in glass) then it is grade A. If sample exhibits wicking but still has a contact angle, then it is a grade C.

10.10.5 On black or dark fabrics, wetting can be detected by loss of “sparkle” within the drop; the aid of a small desk lamp or flashlight may be used for this detection.

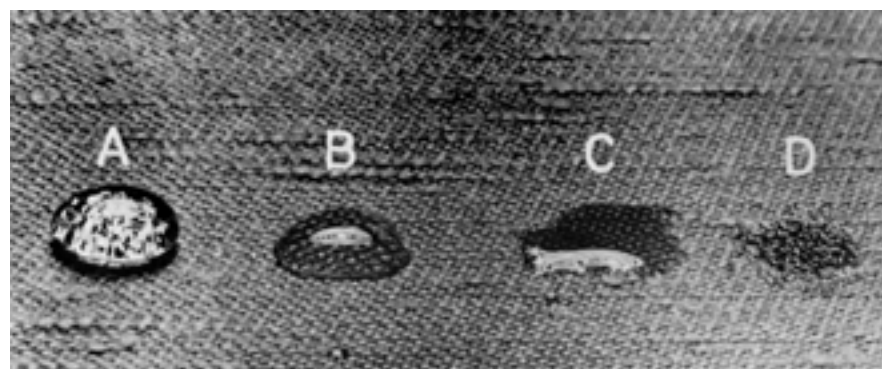
10.11 When the AATCC Oil Repellency Grade for both specimens of a fabric are the same, this is the grade for the sample.

10.12 When the AATCC Oil Repellency Grade for 2 specimens of a fabric



Bottom Row shows Test Liquid 6; Top Row shows Test Liquid 0

Fig. 1—Test liquid placement example.



A = Passes; clear well-rounded drop
B = Borderline pass; rounding drop with partial darkening
C = Fails; wicking apparent and/or complete wetting
D = Fails; complete wetting

Fig. 2—Grading example.