

Test Method for Relative Hand Value of Textiles: Instrumental

1. Purpose and Scope

1.1 This method is for the determination of an instrumental relative hand value (RHV) using the mechanical properties measured on a selected reference fabric and a comparable candidate fabric.

1.2 This method does not purport to replace AATCC EP5, Evaluation Procedure for Fabric Hand, nor are the values obtained by this method known to be comparable to actual tactile sensations felt by human evaluators.

2. Principle

2.1 A specimen is placed over a plate with a specified diameter opening through which a plunger forces the fabric specimen resulting in mechanical deformation data. Force displacement curve data from a reference fabric and a test fabric are used in calculations to produce a Relative Hand Value (RHV).

3. Terminology

3.1 **hand**, n.—the tactile sensations or impressions that occur when fabrics are touched, squeezed, rubbed or otherwise manipulated.

3.2 **reference fabric**, n.—a fabric selected to represent a baseline for comparison of tactile properties of hand.

3.3 **relative hand value**, (RHV) n.—an index of properties, relative to a reference fabric, as determined by either an instrumental system or a subjective hand evaluation that can be used to predict tactile sensations a human perceives when handling a fabric.

4. 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.

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

5. Uses and Limitations

5.1 The results from this method yield

a quantitative description of RHV for use in research and production quality control. A publication describing the historical, theoretical and technical background for the instrumentation on which this test method is based is available (see 13.1).

5.2 The test instrument system produces other hand measurement attributes but this method is specific only to the RHV attribute. Refer to the instrument's instruction manual.

5.3 Caution should be used when comparing the RHVs from fabrics with different yields, constructions, fiber contents and finishes to avoid erroneous conclusions. Correlation to hand panel studies has not been broadly determined. It is the responsibility of the user to determine applicability to their product/needs.

6. Apparatus and Materials

6.1 A relative hand value instrument system (RHV-IS), PhabrOmeter™ System and accessories and PhEST™ software (see 13.2 and Figs. 1 and 2).

6.2 Laboratory gloves and forceps.

6.3 Reference fabric(s). A reference fabric must be of the same density type and class and may be of the same fiber content, construction, processing stage or a fabric that is chosen for comparison against all fabrics to be tested.

7. Conditioning

7.1 Condition reference and test speci-



Fig. 1—PhabrOmeter™ System



Fig. 2—Test Load Plates

mens flat, according to ASTM D1776, Standard Practice for Conditioning and Testing Textiles (see 13.3).

8. Preparation of Reference Fabric

8.1 Multiple reference fabrics should be established and identified using the New Fabric form in the RHV-IS. Each reference fabric should have a separate New Fabric file.

8.2 Perform tests on multiple sets of specimens (see 9.1-9.3) of a selected reference fabric specimen to provide statistical confidence in the force displacement curves for each reference fabric (see 10.1-10.7) and save test data.

8.2.1 For example, if checking the RHV values of an application and variations of the application on woven, 400 g/m² (11.8 oz/yd²), polyester/cotton specimens, the reference fabric data base would be the same fabric that does not have an application or that has been prepared for finishing; therefore, the experimental applications can be compared to the unfinished reference specimen data set.

8.3 Selected reference fabric should be identified according to its class (or type of material). For instance, if one is testing woven fabric specimens one would not select a knitted reference fabric against which to compare.

9. Test Specimens

9.1 Identify the face and back of the specimen to ensure the same side will be tested.

9.1.1 The technical face of a specimen may not always be the one that will be 'touched' when selecting an item to purchase or the one that will be in contact with the skin when used or worn. Before taking specimens, agreement should be reached between parties as to whether the technical face, back or both sides shall be

tested.

9.2 Wear gloves during specimen preparation, as excessive handling and distortion of fabric in any manner must be avoided. Take specimens no nearer to the selvage or edge of the specimen than 10.0% of the fabric width.

9.3 Cut three 113 ± 2 mm (4.5 ± 0.1 in.) diameter specimens from a fabric specimen using the specimen cutter accessory. Where possible, each specimen should contain different groups of lengthwise and widthwise yarns or sites (non-wovens) from specimen locations across the specimen's width that are free of wrinkling.

9.3.1 If sampling from products or garments, select specimens from various locations away from seams, trims, hems or buttons.

10. Procedure

10.1 Start the instrument and software system for testing and open New Fabric form.

10.2 Determine mass of one of the three specimens and record in grams (0.00). If a specimen fabric's construction has the propensity for variable weights (i.e., nonwoven, cheesecloth), measure all three specimens and use the average mass.

10.3 Determine the fabric thickness according to ASTM D1777, Standard Test Method for Thickness of Textile Materials, and record to the nearest mm (see 13.3). If a specimen fabric's construction has the propensity for variable thicknesses (i.e., nonwoven, upholstery), measure all three specimens and use the average thickness.

10.4 Enter the mass (see 10.2) and the thickness (see 10.3) into the opened New Fabric form and select the System's Choice check box then save. Entering this information allows the software to calculate linear density ($\mu\text{g}/\text{cm}$) automatically. Select the appropriate test load plate for the calculated linear density of the specimen being tested (see Table I).

10.4.1 If the candidate specimen has a different linear density as the result of exposure to textile preparation, finishing, or laundering processes than the reference fabric's linear density, then the System's Choice check box should not be checked. The appropriate linear density must be selected manually to assure that the candidate fabric specimen is entered with the same linear density as its reference fabric.

10.5 Set the instrument to Loading Test Plate status and place the appropriate number of test load plates onto the load plate platform.

10.6 Activate the Loading Test Specimen status icon. With gloved hands or forceps, mount the specimen on the specimen holder with the side to be tested facing down and start the test.

10.7 Save the data before loading the next specimen.

10.8 Repeat 10.6 and 10.7 for each remaining specimen.

11. Calculation, Report and Interpretation

11.1 From the deformation extraction curves generated from each specimen, the software calculates the averaged fabric attributes and once a reference fabric is selected a RHV can automatically be produced (see 13.4 and see Appendix A for the formula used in the calculation of RHV).

11.2 Report the produced average RHV for each specimen.

11.3 If a common reference fabric has been selected and confidence in its database has been established, a general ranking of the RHVs for all tested fabrics may be undertaken (see 5.3).

11.4 A smaller RHV value indicates a specimen performs closer to the reference fabric. Other analysis tools may be used to interpret the results.

12. Precision and Bias

12.1 *Interlaboratory Study.* Testing using the Relative Hand Value: Instrumental Method was conducted in 2010 by four laboratories with seven instruments. Laboratories tested five processed specimens that were softened or had other after preparation, dyeing or process treatment. The specimens used in the study were: 100% polypropylene, nonwoven, 1.9 oz/yd²; 100% cotton interlock knit, 6.2 oz/yd²; 100% cotton woven print cloth, 3.2 oz/yd²; 76% Nylon/24% Spandex warp knit, 5.6 oz/yd²; and 100% nylon woven, 3.5 oz/yd². In each laboratory, one operator tested three specimens of each fabric on two different days using different specimens.

12.1.1 One laboratory whose instrument's calibration was verified by the instrument manufacturer performed testing on each of the specimen fabrics in their unfinished state. Those data files were

sent to each laboratory for use with their instrument's calculation of Relative Hand Value for each specimen in the study set.

12.1.2 The analysis of variance technique was used on the data collected. A full report is on file for reference at the AATCC Technical Center.

12.1.3 *Precision.* The components of variation of the Relative Hand Values by fabric as standard deviations of are given in Table II.

Results showed that the hand values evaluated on Day 1 and Day 2 were not significantly different at the 95% confidence level. Results also showed that the hand values obtained under different standard atmospheres (23°C [73°F], 50% RH and 22°C [72°F], 65% RH) were not significantly different at 95% confidence level. *Within laboratory* and *between laboratories* precision and critical differences are given in Tables III and IV.

12.2 *Bias.* The true value of the relative hand value can be defined only in terms of a test method. There is no independent method for determining the true value. As an estimate of this property, this test method has no known bias.

13. Notes

13.1 Pan, Ning, Quantification and Evaluation of Human Tactile Sense Towards Fabrics, *International Journal of Design & Nature*, Vol. 1, 2007, pp48-60; web site: www.phabrometer.com/FAQ/MajorPaper.pdf.

13.2 A RHV-IS, the PhabrOmeter™ System, accessories and PhES™ software, can be purchased from Nu Cybertek Inc., 2925 Spafford, Ste. D, Davis CA 95618; tel: +1.530.758.3258; toll-free: +1.877.718.1880; fax: +1.888.566.1298; e-mail: info@nucybertek.com; web site: www.nucybertek.com.

13.3 Available from ASTM International, 100 Barr Harbor Dr., W. Conshohocken PA 19428; tel: +1.610.832.9555; fax: +1.610.832.9555; web site: www.astm.org.

13.4 A fabric's end use may determine which side of a specimen will be tested but if unknown, either side of the fabric may be tested. However, the direction in which specimens are tested needs to be consistent. For

Table I—Test Load Plates by Linear Density

Fabric Description	Linear Density, $\mu\text{g}/\text{cm}$	# of Plates to Use
Super light	<280	None
Light	280 ~ 1200	1
Medium	1200 ~ 3440	2
Heavy	>3440	3

Table II—Summary Data for Day 1 and Day 2 with Standard Deviations

Specimen ID	RHV Minimum	RHV Maximum	RHV Mean	SD
Nonwoven	0.056	0.151	0.086	0.03
Cotton knit	1.493	1.913	1.772	0.15
Cotton woven	0.273	0.541	0.385	0.10
Nylon/spandex warp knit	0.300	0.534	0.399	0.08
Nylon woven	0.201	0.397	0.287	0.06