Designation: D5252 – 15

Standard Practice for the Operation of the Hexapod Tumble Drum Tester[1]

This standard is issued under the fixed designation D5252; 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 practice describes the equipment and operation of the hexapod tumble drum tester for testing pile floor covering to produce changes in appearance and color due to changes in surface structure by mechanical action tester.

1.2 This practice is applicable for use in testing unused pile floor covering of all types. It is not applicable for use in testing used pile yarn floor coverings.

1.3 This practice may be used by mutual agreement between the purchaser and supplier to set purchasing specifications.

1.4 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.5 *This practice 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 practice 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]

D123 Terminology Relating to Textiles

D1776 Practice for Conditioning and Testing Textiles

D5684 Terminology Relating to Pile Floor Coverings

3. Terminology

3.1 For all terminology related to Pile Floor Coverings, D13.21, see Terminology D5684.

3.1.1 The following terms are relevant to this standard: carpet, finished, finished pile yarn floor covering, floor covering, lengthwise direction, pile, pile lay, pile yarn floor covering, pitch, practice, primary backing, secondary backing, textile floor covering, texture, tufted fabric.

3.2 For all other terminology related to textiles see Terminology D123.

4. Summary of Practice

4.1 The specimen is secured to a backing sheet that is mounted inside the rotatable drum with the pile surface exposed. A metal hexapod, with six polyurethane studs, rolls randomly on the pile surface inside the rotating drum for a specified number of revolutions.

5. Significance and Use

5.1 This equipment may be used to bring about the changes in appearance and texture on the surface of pile floor covering caused by mechanical action.

6. Apparatus, Materials, and Reagent

6.1 *Hexapod Tumble Tester*

6.1.1 *Drum*—Constructed of Nylon or other like material and capped by a lid that is secured by a latching device. The drum base and lid have a locating groove to hold the specimen backing sheet flat to the inner wall of the drum. A photograph of a typical drum is shown in Fig. 1 and Fig. 2. The drum dimensions are:

Internal Diameter	12 ± 0.18 in.	(302 ± 5 mm)
Wall Thickness	0.3 in. approx.	(8 mm approx.)
Internal Depth	8.2 ± 0.02 in.	(207 ± 5 mm)

6.1.2 *Driving System,* cradles the drum on rollers and keeps the axis of the drum level, and rotates the drum at 35 ± 2 rpm (3.6 ± 0.2 rad/s). The driving direction reverses after approximately 500 revolutions. After the 500 rotations the unit will stop and stand stationary for approximately 5 to 15 s, then begin rotating in the opposite direction. After 2000 rotations the unit will stop and wait for the operator to restart the unit.

6.1.3 *Hexapod Tumbler*—There are two types of Hexapod Tumblers: the 2.8 lb (1270 g) or the 8.4 lb (3810 g) as specified below. The selection of which depends on the end use of the pile floor covering.

NOTE 1—The 2.8 lb Residential Hexapod Tumbler is recommended for residential pile floor covering test applications and the 8.4 lb Commercial Hexapod Tumbler is recommended for commercial pile floor covering applications.

6.1.3.1 *8.4 lb Commercial Hexapod Tumber*—Comprised of a steel (or other suitable material) 2.0 ± 0.04 in. (50 ± 1 mm) cube with 1-in. (25-mm) thick plates welded to each side. The

[1] This practice is under the jurisdiction of ASTM Committee D13 on Textiles and is the direct responsibility of Subcommittee D13.21 on Pile Floor Coverings.

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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.

FIG. 1 Typical Front View of Drum Cover

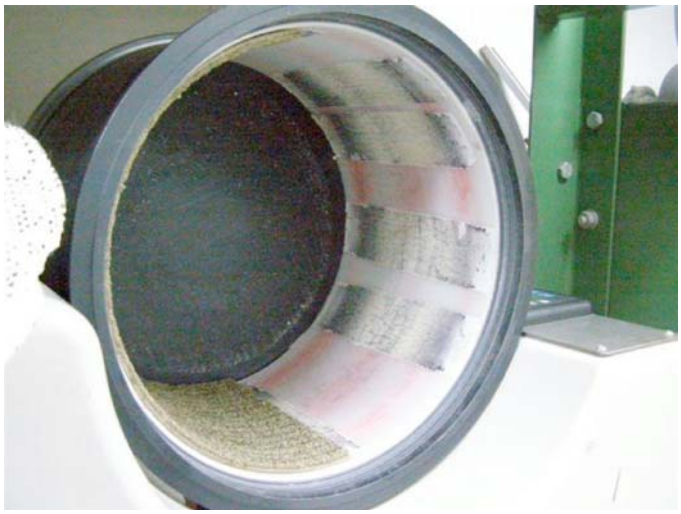

FIG. 2 Typical Inside of Drum without Cover

outside corners are welded such that when the studs are fitted and the hexapod placed on a flat surface, no metal touches the flat surface. The total length of any axis, not including hexapod feet, should be 3.8 ± 0.08 in. (96 ± 2 mm). Replaceable tumbler feet (see 6.1.3.3) are screwed centrally into each face. The specified total mass of Commercial Hexapod Tumbler with six feet installed is 8.4 ± 0.2 lb (3810 ± 90 g). A photograph of a typical 8.4 lb Commercial Hexapod Tumbler is shown in Fig. 3.

6.1.3.2 *2.8 lb Light Residential Hexapod Tumbler*—Comprised of aluminum (or other suitable material) 2.00 ± 0.04 in. (50 ± 1 mm) cube with 25-mm (1-in.) thick plates welded to each side. The outside corners are welded such that when the studs are fitted and the hexapod placed on a flat surface, no metal touches the flat surface. Alternatively, the ball may be milled from a solid block if the construction meets the specification. The total length of any axis, not including hexapod studs, should be 3.8 ± 0.08 in. (96 ± 2 mm). Replaceable tumbler feet are screwed centrally in each face. The specified total mass of the Residential Hexapod Tumbler

FIG. 3 8.4 lb Commercial Hexapod Tumbler

with six feet installed is 2.8 ± 0.13 lb (1270 ± 60 g). A photograph of a typical 2.8 lb Residential Hexapod Tumbler is shown in Fig. 4.

6.1.3.3 *Hexapod Tumbler Feet Specifications (see* Fig. 5*)*—Tumbler Feet parameters are:

Diameter of Foot	1.60 ± 0.04 in. (40 ± 1 mm)
Height of Foot	0.60 ± 0.04 in. (15 ± 1 mm)
Edge of Radius Stud	0.60 ± 0.04 in. (15 ± 1 mm)
Steel Backing for Polyurethane	
Foot Hardness	8.3 ± 6 Type A Durometer
Foot Thickness	0.12 ± 0.01 in. (3.00 ± 0.25 mm)
Threading for 0.75 in. Bolt to attach Foot to Tumbler	Metric M8 – 1.25 (typical)

6.2 *Specimen Backing Sheet,* polyethylene approximately 375 by 8.5 by 0.08 in. (approximately 950 by 215 by 2 mm).

6.3 *Tape,* double-sided adhesive, approximately 2.0 in. (50 mm) width.

6.4 *Vacuum Cleaner*—Each specimen shall be vacuumed and pile erected with a hand-held vacuum that meets the following general specifications: powered rotating brush, bag less design, HEPA filtration, 7 A motor, nozzle width 6.5 ± 0.3

FIG. 4 2.8 lb Residential Hexapod Tumbler

FIG. 5 Typical Hexapod Tumbler Foot

in. (165 ± 7 m), and overall weight 6.5 ± 0.5 lb (3.0 ± 0.2 kg). Replace the rotating brush when the bristle length changes more than 15 % of the original length. An upright vacuum approved in the CRI Seal of Approval Program shall be acceptable for use in this practice.

6.5 *Cleaning Frame (optional),* a rectangular frame approximately 40 by 12 in. (1000 by 300 mm) with a central rectangular aperture approximately 37 by 8 in. (940 by 200 mm) to receive the test specimen. The frame should be made from a material of similar construction to the test specimen and mounted on a rigid backing sheet.

6.6 *Solvent*—Use only ethyl alcohol, or isopropyl alcohol, technical grade.

7. Preparation of Specimen

7.1 *Marking Specimen*—Before cutting out the test specimen, mark on the backing the direction of manufacture with the head of the arrow pointing in the same direction as the lay of the pile.

7.2 *Size of Specimen*—Cut the specimen approximately 37 by 8 in. (940 by 200 mm) with the long dimension parallel to the lengthwise direction of the pile yarn floor covering. Take no specimen within 4.0 in. (100 mm) of the trimmed selvedge. Alternatively, up to four smaller specimens of similar thickness may be tested together, although if this is done, the effect of fiber or finish must be considered. If this is the case, cut the specimen to allow for a 0.2-in. (5-mm) gap between each specimen, and ensure that the pile lay is in the same direction.

NOTE 2—Texture change results can be noticeably different when testing a specimen in the machine direction versus across the machine direction.

7.3 *Cleaning of Specimen*—Prior to testing, vacuum the specimen to remove any loose tufts or fibers.

7.4 *Specimen Attachment*—Attach the double-sided adhesive tape along each side and across the end of the specimen backing sheet leaving approximately 0.2 in. (5 mm) clear at each edge, pressing down firmly to ensure adhesion. If testing multiple specimens, attach an additional strip tape at each cross junction. Mount the specimen pile surface uppermost, allowing a 0.2 in. (5 mm) gap at the end and between 0.2 to 0.4 in. (5 to 10 mm) between specimens to allow space for the pile when the backing sheet is curved to fit the drum.

8. Conditioning

8.1 Condition and determine that moisture equilibrium for testing has been attained as directed in Practice D1776.

9. Procedure

9.1 Perform this practice on a specimen prepared as described in Section 8, maintaining the Hexapod Tumble Drum Tester in a temperature controlled atmosphere of 70 ± 5°F (21 ± 3°C) for testing textiles.

9.2 Wipe the hexapod tumbler and the inside of the drum with a clean lint-free tissue or cloth and one of the recommended solvents.

9.3 Ensure that the Hexapod Tumble Drum Testing Unit has been maintained to the recommended checks found in Annex A1.

9.4 Ensure that the specimen lies smoothly around the internal circumference when the backing sheet is curved to fit the drum and that it is firmly held in place by the locating grooves. If necessary, adjust the specimen length.

9.5 Place the selected hexapod tumbler in the drum on the specimen surface.

9.6 Secure the lid to the drum and position the drum on the rollers of the drive mechanism. Ensure that the drum is level.

9.7 Set the revolution counter for 2000 revolutions. When the machine stops, remove the mounted specimen and prepare to vacuum the specimen. An optional central aperture of the cleaning frame can be used to hold the specimen.

9.8 Using the vacuum cleaner, make four passes (1 pass = 1 forward and back motion) along the length of the mounted specimen. The entire specimen must be vacuumed and the final pass must be in the lay of the pile.

9.9 Return the mounted specimen to the drum and repeat 9.4 – 9.8 until the required number of rotations has been completed.

9.10 Do not let the tumbler lay on the specimen without movement for more than 2 h.

10. Report

10.1 State that the tester was operated as directed in Practice D5252.

10.2 Report the following information:

10.2.1 The number of drum rotations.

10.2.2 The type of vacuum cleaner used.

10.2.3 Detail any deviations from this practice.

10.2.4 The type of Tumbler used (8.4 lb Commercial Hexapod Tumbler or 2.8 lb Residential Hexapod Tumbler).

11. Keywords

11.1 appearance; carpet; floor covering; hexapod; pile yarn

ANNEX

A1. HEXAPOD POD UNIT, QUALITY CONTROL AND REPEATABILITY PROCESS (Mandatory Practices)

(Mandatory Information)

A1.1 To ensure unit to unit reproducibility, it is important for every unit and tumbler combination to be evaluated for conformance to the specifications listed in this annex. The operators of this equipment must understand and consistently observe the running of the equipment and report any discrepancies for repair.

A1.2 Verify the r/min of each machine is 35 ± 2 r/min at least weekly. If the r/min is not within specification then take the unit out of service, and check the following

A1.2.1 Drive belt worn or out of tension.

A1.2.2 Evaluate counting system for improper set up or function. If using a reflectance system replace tape/clean eyes. If using a metal proximity system evaluate the distance between sensors.

A1.2.3 If r/min is not within specification then make an adjustment to the speed to obtain the proper r/min.

A1.2.4 If the unit is gear driven, consider changing drive pulley size or converting unit to variable drive system.

A1.3 Evaluate operational control of the hexapod unit at least once every 6 months. If the unit fails any of the verifications remove the unit from service until repaired.

A1.3.1 Check each unit's programmed rotation cycle. The unit must rotate in one direction for approximately 500 rotations (or 14.5 min); stop, wait approximately 60 s, and then rotate in the opposite direction for another 500 rotations (or 14.5 min). The unit's control system should produce a cycle of 2000 rotations; stop and wait for the operator to remove the specimen for vacuuming.

A1.3.2 Ensure that the unit stops when the desired number of rotations has been obtained.

A1.4 Hexapod Tumblers should be weighed with new hexapod feet installed. If weight is out of specification make necessary changes to ensure tumbler is in specification.

A1.4.1 Weight for 8.4 lb Commercial Hexapod Tumbler 8.40 ± 0.20 lb (3810 ± 90 g)

A1.4.2 Weight for 2.8 lb Residential Hexapod Tumbler 2.80 ± 0.13 lb (1270 ± 60 g)

A1.5 Hexapod Tumbler feet should meet all specifications for manufacture, and should be evaluated for the following attributes before being put into service, and during the normal course of it usefulness. Check each foot for cuts, tears, abrasions, and any other damage or imperfections that might cause additional texture change to the test specimen. If found discard the foot, and replace with a new foot.

A1.5.1 Shape must meet the specifications found in 6.1.3.3. Shape will change over time; visually check specimen versus a control Tumbler Foot, and determine if the shape is changing. If the shape becomes visually different discard all studs and replace with new.

A1.5.2 Check hardness of stud versus 6.1.3.3. Typically, the hardness will change with usage. If the hardness exceeds the tolerance remove from use.

A1.6 *Break In Period for New Hexapod Feet:*

A1.6.1 When installing a complete set of new hexapod feet, run the ball with new feet for 24 h on a trial carpet specimen (no vacuuming required). This break in period is necessary to ensure accurate results for the life of the stud.

A1.6.2 If the unit has been in constant use, it is recommended that the feet of a hexapod unit be replaced every 6 months or 1 million cycles. Constant use equals >20 h/week for 26 weeks.

A1.7 *Hexapod Unit to Unit Texture Change Evaluation*—If multiple hexapod units are used within a facility, an evaluation of the texture change produced should be conducted twice per year. Specimen for the evaluation should be sampled from the same carpet sample. The results are evaluated to ensure each unit will produce similar texture change results.