Designation: F 1566 – 99 (Reapproved 2004)

Standard Test Methods for Evaluation of Innersprings and Boxsprings[1]

This standard is issued under the fixed designation F 1566; 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 These test methods cover nationally recognized methods for testing mattress innersprings and boxsprings to ensure uniformity of results.

1.2 These test methods are applicable to un-upholstered innersprings and boxsprings only and are not applicable to finished upholstered mattresses or boxsprings. Any conclusions covering such items are outside the scope of these test methods.

1.3 The durability test (Section 7), impact test (Section 8) and firmness retention test (Section 9) require the use of an upholstered innerspring or boxspring, or both. A standardized upholstery is specified in each case.

1.4 The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are for information only.

1.5 *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 648 Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position

E 4 Practices for Force Verification of Testing Machines

3. Terminology

3.1 *Definitions:*

3.1.1 *boxspring unit, n*—foundation for the mattress consisting of wire spring elements mounted on a frame.

3.1.2 *boxspring, upholstered, n*—foundation for the mattress consisting of wire spring elements mounted on a frame, generally upholstered and covered on top and sides with ticking, and bottom with a dust cover.

3.1.3 *contract units, n*—term used to indicate units marketed in large quantities, usually by contract, to quantity users, that is, hotel, motel, institutional, etc.

3.1.4 *innerspring unit, n*—interconnection of wire spring elements other than mounting on a frame that forms a single unit that can be incorporated into a mattress.

3.1.5 *mattress, innerspring, n*—any mattress containing an innerspring unit.

3.1.6 *posturized innerspring, n*—innerspring assembly with the center third having a higher coil density or larger wire gage.

4. Significance and Use

4.1 Four separate test methods are outlined for use in evaluation of mattress innerspring or boxspring units, or both.

4.2 These test methods include measurements of firmness, firmness retention, durability, effect of impact, etc.

4.3 One or more of the test methods shall be used separately or in combination to provide for appropriate evaluations.

5. Conditioning

5.1 Prior to testing, condition units for at least 8 h at 23 ± 5°C in accordance with Test Method D 648.

6. Firmness Rating

6.1 *Specimen*—The unit to be tested is an un-upholstered mattress innerspring or boxspring unit.

6.2 *Apparatus*:

6.2.1 *Platen*—The platen shall be a round aluminum disk weighing 8 ± 0.2 lb (3.6 ± 0.1 kg) with a diameter of 13.54 ± 0.2 in. (344 ± 5 mm) connected to the loading mechanism with a flexible connection (see Fig. 1).

6.2.2 *Loading Mechanism*[3]—A device capable of providing a load of 300 lbf (1335 N) or more with accuracy of ±1 %.

6.2.3 *Deflection Device*—For use in determining deflection, that is, ruler or electronic device accurate to 1/32 in. (1 mm).

6.3 *Test Procedure*:

6.3.1 Place specimen directly onto a rigid, flat surface.

6.3.2 Run tests at four separate locations as shown in Fig. 2; Location 5 being optional.

6.3.3 At each test location, determine resistance values in 0.5-lbf (2-N) increments at 0.5, 1, 1.5, 2, 2.5, and 3 in. (12.5, 25, 38, 50, 63, and 76 mm) with a tolerance of ±0.04 in. (±1

[1] These test methods are under the jurisdiction of ASTM Committee F15 on Consumer Products and are the direct responsibility of Subcommittee F15.32 on Innersprings and Boxsprings.

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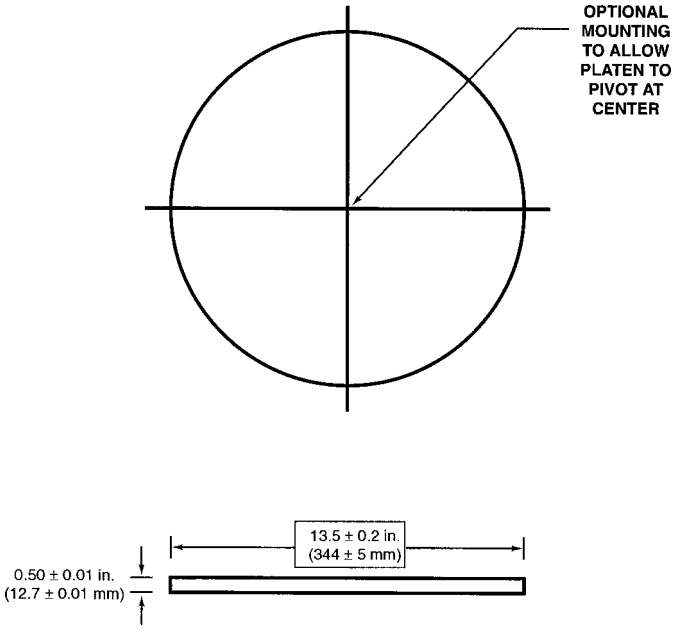
[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] See Practices E 4 for calibration techniques.



NOTE 1—Platen material: aluminum.
Weight: 8 ± 0.2 lb (3.6 ± 0.1 kg)

FIG. 1 ILD Platen

mm) of deflection of the top surface for innersprings and 0.5 and 1 in. (12.5 and 25 mm) with a tolerance of ±0.04 in. (±1 mm) of deflection of the top surface for boxsprings.

6.4 *Calculation/Results*:

6.4.1 Determine a firmness rating for uniformly constructed innerspring units by totaling resistance values at Locations 3 and 4 for all deflections and dividing the total by 2 (for an average).

6.4.2 Determine firmness rating for non-uniformly constructed (posturized) innerspring units by using resistance values at Location 3 only.

6.4.3 Determine a firmness rating for the calf/shoulder area using the values at Location 4 only. Any difference between readings 3 and 4 will be calculated as a percentage of increase of Location 3 over the readings at Location 4.

6.4.4 Determine a firmness rating for the edge by totaling the resistance values at Locations 1 and 2 for all deflections and dividing the total by 2 (for an average).

6.4.5 *Optional*—Determine a firmness rating of the corner by totaling as the resistance value for all deflections at Location 5.

7. Durability Test

7.1 *Specimen*:

7.1.1 When testing innerspring units, standard upholstered boxsprings shall be used for the comparison. Conversely, when testing boxspring units, standard innerspring mattresses shall be used. A 312-coil, 13-gage, 0.092-in. (2.34-mm) diameter, tempered steel spring wire, 5-turn, shall be the standard test innerspring unit and an 81-coil, 10-gage, 0.135-in. (3.4-mm) diameter, tempered steel spring wire boxspring unit shall be the standard foundation construction.

7.1.2 The border wire on the innerspring and boxspring units shall be a minimum of 6-gage, 0.192-in. (4.9-mm) diameter.

7.1.3 The test upholstery for the innerspring mattress will be a 1.85 ± 0.15 oz/ft^2 (565 ± 45 g/m^2) synthetic fiber pad primary insulation layer positioned next to the subject on both flat surfaces. A0.75-in. (19-mm) thick 1.1 ± 0.1-lb/ft^3 (17.5 ± 1.5-kg/m^3) density, 25 to 35-lbf (110 to 155-N) polyurethane foam cushioning layer shall be placed on top of the primary insulator pad on each side. A quilt assembly sandwich shall be constructed consisting of a top layer of 100-end damask fabric ticking. The middle layer of 0.5-in. (13-mm) thick, 1.1 ± 0.1-lb/ft^3 density, 25 to 35-lbf polyurethane foam and the bottom layer is of 1.0 ± 0.5-oz/yd^2 (34 ± 17-g/m^2) quilt backing.

7.1.4 This assembly shall be unitized by automatic sewing and then placed over the foam cushioning layer on both sides and attached to the subject mattress innerspring, using techniques commonly accepted by the bedding industry.

7.1.5 The boxspring assembly shall be upholstered with a 1.85 ± 0.15-oz/ft^2 (52.4 ± 4.0-g/m^2) synthetic fiber pad primary insulator next to the subject boxspring. The fabric of commercially acceptable grades shall be placed directly over the pad and attached to the spring and wood assembly, using techniques commonly accepted by the bedding industry.

7.2 *Apparatus*:

7.2.1 *Juggernaut Roller*[4] (see Fig. 3),

7.2.1.1 *Shape of Roller*, 6-sided,

7.2.1.2 *Length*, 36 ± 3 in. (915 ± 75 mm),

7.2.1.3 *Weight*, 240 ± 10 lb (109 ± 4.5 kg),

7.2.1.4 *Diameter of Roller (Flat to Flat)*, 17 ± 1 in. (430 ± 25 mm),

7.2.1.5 *All Sharp-Edged Radiuses*, not to exceed 2 in. (50 mm),

7.2.1.6 *Operating Speed*, not to exceed 20 cycles/min, and

7.2.1.7 *Roller*, should float free of arm.

7.2.2 *Deflection Device*—A method of determining deflection, that is, ruler or electronic device accurate to 1/32 in. (1 mm).

7.3 *Test Procedure*:

7.3.1 Determine a firmness rating of the un-upholstered specimen in accordance with Section 6.

7.3.2 Place unupholstered specimen directly on a rigid, flat surface.

7.3.3 Measure height of unupholstered specimen at Position 3 (see Fig. 2).

7.3.4 Upholster specimens as described in 7.1.3-7.1.5.

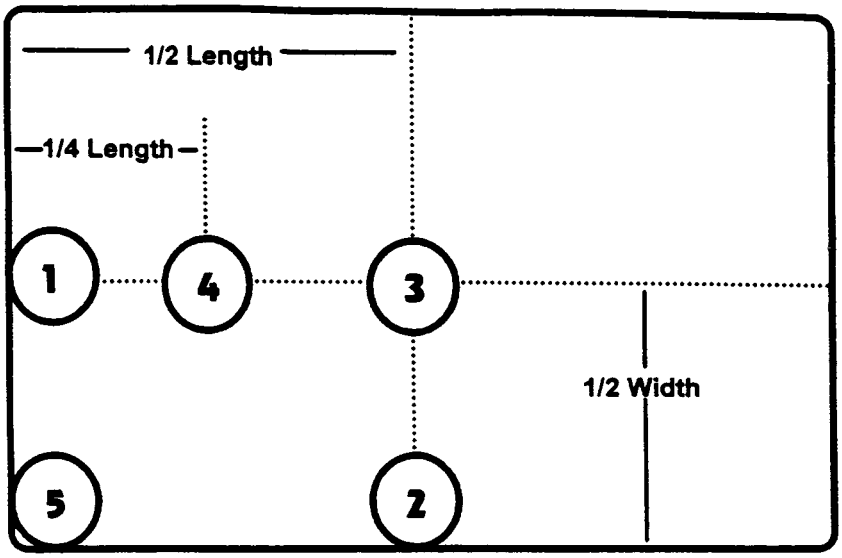
7.3.5 Testing shall be done in the center of the mattress (measured from head to foot) across the mattress surface from side to side.

NOTE 1—This simulates sleeper action most realistically.

7.3.6 A hold down device shall be used outside of the roller path to keep mattress from moving.

7.3.7 The maximum stroke of the roller shall be the width of the mattress, minus the width of one flat side of the roller.

[4] Detailed construction drawings for this equipment are available from American Innerspring Manufacturers Association, 1918 North Parkway, Memphis, TN 38112.



NOTE 1—At Locations 1, 2, and 5, platen is flush outside of border (Location 5 is optional).
NOTE 2—*Platen Size*—Round aluminum weighing 8± 0.2 lb (3.629 ± 0.1 kg) with 13.54 ± 0.2 in. (343.9 ± 8 mm) diameter (represents 1 ft^2).

FIG. 2 Innerspring and Boxspring Test Locations

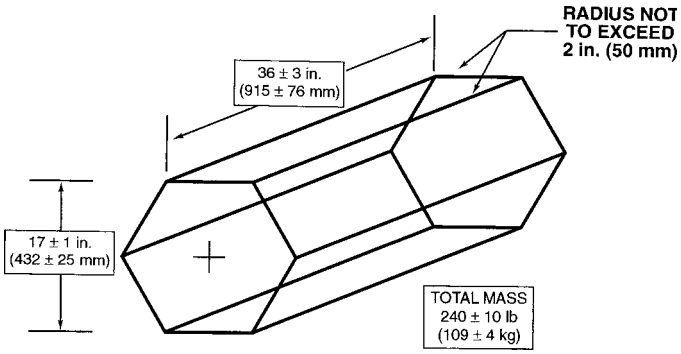


FIG. 3 Six-Sided Roller

7.3.8 The roller starting position, measured from the center line of the roller, shall be ½ the width of the roller from the side of the mattress, with the flat face of the roller resting on the surface of the mattress.

7.3.9 The minimum stroke shall be no less than 70 % of the width of the mattress, or 38 in. (965 mm), whichever is smaller.

7.3.10 The mattress shall remain in the same position throughout the entire test. If the test is interrupted, the roller should be lifted from the set and should be returned to the original starting position for testing to resume.

7.3.11 A stroke is determined by one pass across the test area and a cycle determined by two strokes or two passes.

7.3.12 The test shall be continued for a total of 100 000 cycles.

7.3.13 Remove upholstery.

7.3.14 Measure decrease in height at Position 3 (see Fig. 2).

7.3.15 Determine the final firmness rating of the specimen in accordance with Section 6.

7.4 *Report*—Report the following information:

7.4.1 Any decrease in height (in. or mm),

7.4.2 Any change in firmness rating (see Section 6), and

7.4.3 Any damage such as structural failures, broken coils, etc.

8. Impact Test

8.1 *Specimen*:

8.1.1 A 312-coil, 13-gage, 0.092-in. (2.34-mm) diameter, tempered steel spring wire, 5-turn, shall be the standard test innerspring unit.

8.1.2 The border wire on the innerspring unit shall be 6-gage 0.192-in. (4.9-mm) diameter, steel border wire.

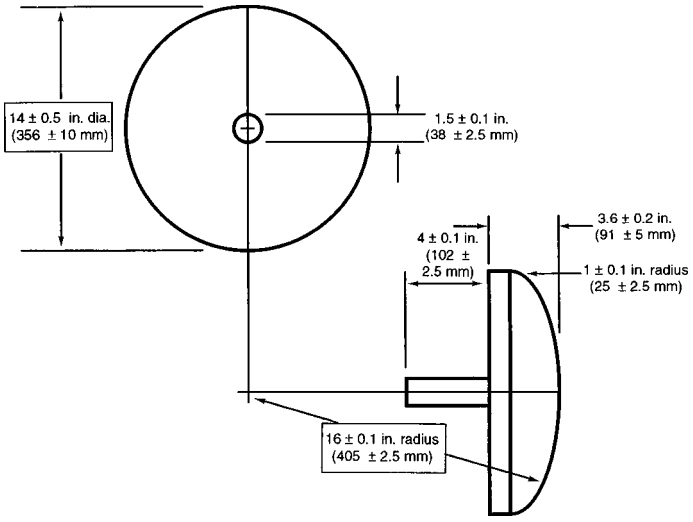
8.1.3 The test upholstery for the innerspring mattress shall be a 1.85 ± 0.15-oz/ft^2 (565 ± 45-g/m^2) synthetic fiber pad insulation layer positioned next to the subject on both flat surfaces. A0.75-in. (19-mm) thick, 1.1 ± 0.1-lb/ft^3 (17.5 ± 1.5-kg/m^3) density, 25 to 35-lbf (110 to 155-N) polyurethane foam cushioning layer shall be placed on top of the primary insulator pad on each side. A quilt assembly sandwich shall be constructed consisting of a top layer of 100-end damask fabric ticking. The middle layer is 0.5-in. (13-mm) thick, 1.1 ± 0.1-lb/ft^3 density, 25 to 35-lbf polyurethane foam and the bottom layer is of 1.0 ± 0.5-oz/yd^2 (34 ± 17-g/m^2) quilt backing.

8.1.4 This assembly shall be unitized by automatic sewing and then placed over the foam cushioning layer on both sides and attached to the subject mattress innerspring, using techniques commonly accepted by the bedding industry.

8.1.5 The boxspring assembly shall be upholstered with a 1.85 ± 0.15-oz/ft^2 (52.4 ± 4 g/m^2) synthetic fiber pad primary insulator next to the subject boxspring. The fabric cover of commercially acceptable grades shall be placed directly over the pad and attached to the spring and wood assembly, using techniques commonly accepted by the bedding industry.

8.2 *Apparatus*:

8.2.1 *Platen*—A 14.0 ± 0.5-in. (355 ± 10-mm) diameter disk as shown in Fig. 4 with a total mass of 175 ± 2 lb (79.5 ± 1.0 kg).



NOTE 1—Weight: 175 ± 2 lb (79.38 ± 1 kg).

FIG. 4 Impact Test Platen

8.2.2 *Drop Weight Equipment*—A device capable of lifting the platen to a controlled height not to exceed 2 ft (610 mm) over the top surface of the specimen and designed to release the platen in "free drop" such that the vertical component is free but the horizontal component is restrained.

8.3 *Test Procedure*:

8.3.1 Place the specimen directly on a rigid, flat surface.

8.3.2 Select drop locations to compare performance at various positions (1 through 5) as shown in Fig. 2:

NOTE 2—For safety reasons, it is recommended that the platen not extend beyond the edge/end of the mattress during any drop test to prevent high side loads from being generated.

8.3.3 Measure the original height of the unupholstered specimen at Locations 1 through 5 as shown in Fig. 2. Height must be measured from the top of the spring element to the bottom of the support span. Any change in height would be recorded as permanent set or deformation.

8.3.4 Drop heights are measured above the surface of the mattress at the location being tested.

8.3.5 For comparative testing, the drop height shall be constant for each sample set being tested.

8.3.6 Drop the platen from a height of 1 in. (25 mm) above the surface of the mattress at each of five positions (see Fig. 2).

8.3.7 Measure the heights of the specimen at five positions (see 8.3.3).

8.3.8 Repeat 8.3.6 and 8.3.7 at 1-in. (25-mm) increments until there is 0.75-in. (19-mm) permanent deformation or structural failure.

8.4 *Calculation/Results*:

8.4.1 Record after each series of impacts the following information:

8.4.1.1 Permanent deformation of support elements, and

8.4.1.2 Any structural failures.

9. Firmness Retention and Surface Deformation[5]

9.1 *Specimen*:

9.1.1 When testing innerspring units, standard upholstered boxsprings shall be used for the comparison. Conversely, when testing boxspring units, standard innerspring mattresses shall be used. A 312-coil, 13-gage, 0.092-in. (2.34-mm) diameter, tempered steel spring wire, 5-turn, shall be the standard test innerspring unit and an 81-coil, 10-gage, 0.135-in. (3.4-mm) diameter, tempered steel spring wire boxspring unit shall be the standard foundation construction.

9.1.2 The border wire on the innerspring and boxspring units shall be a minimum of 6-gage, 0.192-in. (4.9-mm) diameter.

9.1.3 The test upholstery for the innerspring mattress shall be a 1.85 ± 0.15-oz/ft^2 (565 ± 45-g/m^2) synthetic fiber pad primary insulation layer positioned next to the subject on both flat surfaces. A0.75-in. (19-mm) thick 1.1 ± 0.1 lb/ft^3 (17.5 ± 1.5-kg/m^3) density, 25 to 35 lbf (110 to 155-N) polyurethane foam cushioning layer shall be placed on top of the primary insulator pad on each side. A quilt assembly sandwich shall be constructed consisting of a top layer of 100-end damask fabric ticking. The middle layer of 0.5-in. (13-mm) thick, 1.1 ± 0.1-lb/ft^3 density, 25 to 35-lbf polyurethane foam and the bottom layer is of 1.0 ± 0.5-oz/yd^2 (34 ± 17-g/m^2) quilt backing.

9.1.4 This assembly shall be unitized by automatic sewing and then placed over the foam cushioning layer on both sides and attached to the subject mattress innerspring, using techniques commonly accepted by the bedding industry.

9.1.5 The boxspring assembly shall be upholstered with a 1.85 ± 0.15-oz/ft^2 (52.4 ± 4-g/m^2) fiber pad primary insulator next to the subject boxspring. The fabric of commercially acceptable grades shall be placed directly over the pad and attached to the spring and wood assembly, using techniques commonly accepted by the bedding industry.

9.2 *Principle*:

9.2.1 *Testing Machine*:

9.2.1.1 Applies repeated controlled, counted strokes of a rounded end plunger (ram head) acting on the surface of the mattress and boxspring set,

9.2.1.2 Measures the support firmness of the mattress and boxspring set,

9.2.1.3 Measures the deformation of the mattress and boxspring set in the form of a dimple on the surface of the mattress, and

9.2.1.4 Applies forces that resemble those in actual use and can be used to test any type of mattress and boxspring unit, regardless of the materials of construction.

9.2.2 Support firmness is the ability of a mattress and boxspring set to resist indentation when weight is applied. This procedure provides a means of comparing a characteristic that relates to firmness.

9.2.3 Cumulated dimple is the result of applied force to the surface of the mattress and boxspring set. In this test it is measured by the depth of compacting, or dimpling, after repeated strokes of the plunger and ram head. The depth of the dimple is measured in inches.

9.2.4 The load deflection curve shows graphically the manner in which a bedding set deflects under various applied forces from 0 to 230 lbf (0 to 1025 N).

[5] Referred to in the industry as the "Cornell Test."

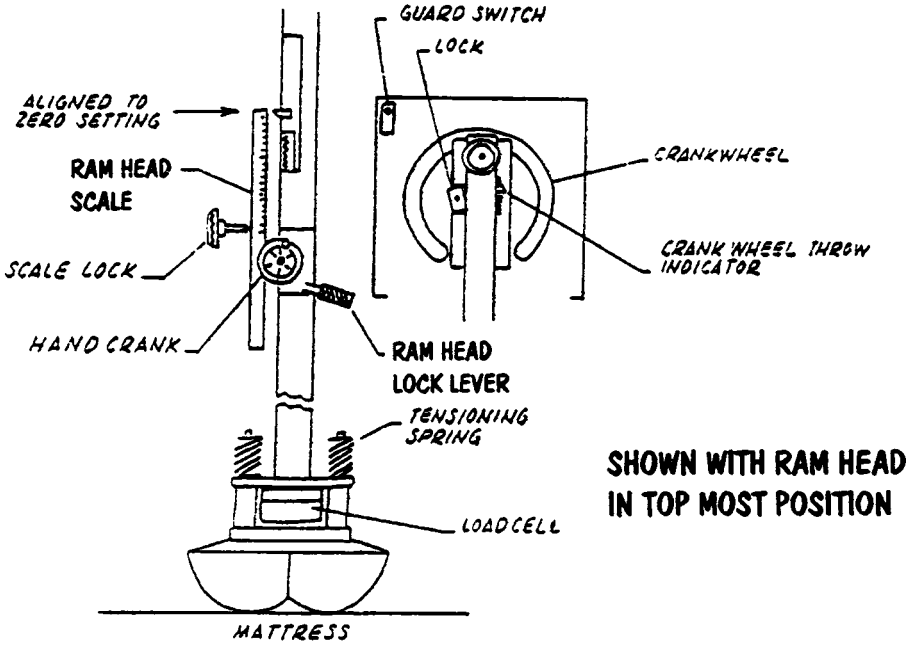


FIG. 5 Ram Head Details

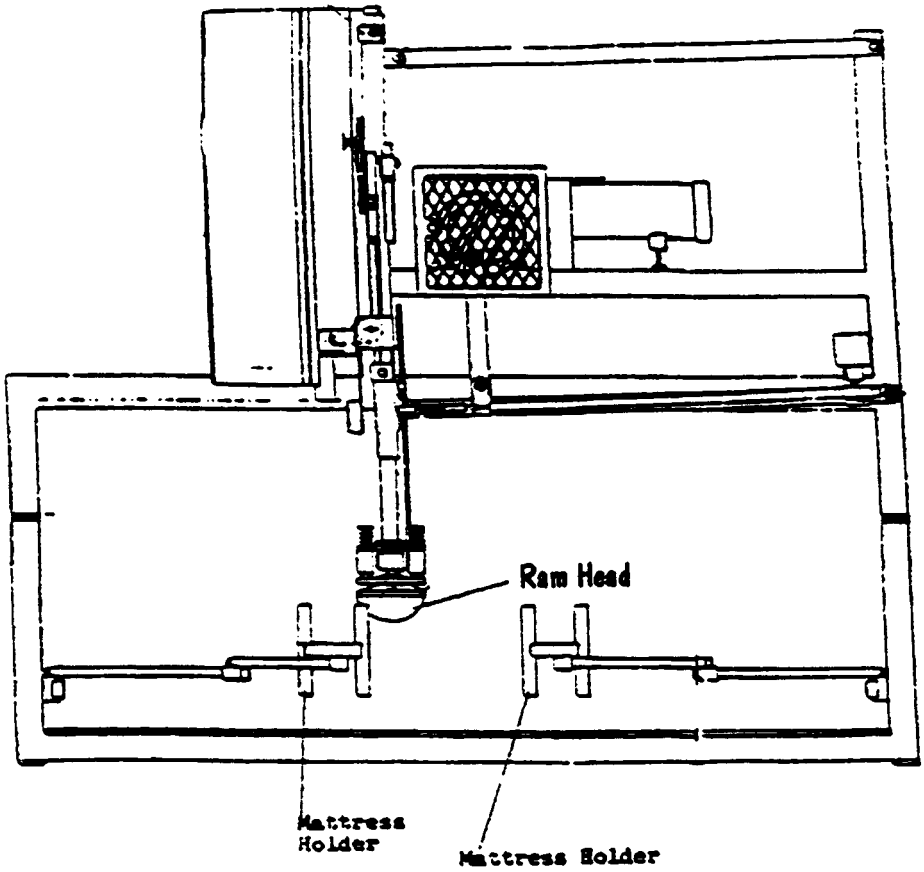


FIG. 6 Testing Machine—Firmness and Deformation

9.3 *Apparatus*:

9.3.1 *Testing Machine*—A machine that applies repeated, controlled, counted strokes of a round-end plunger (ram head) to the surface of the specimen (see Figs. 5 and 6). The readout on the load cell shall be digital, the "throat opening" (height between the plunger and rigid, level surface) shall be a

minimum of 26 in. (660 mm), the load cell shall have a minimum capacity of 500 lbf (2225 N).[6] The tester consists of a reciprocating plunger that repeatedly applies a preset deflection to the test mattress, and automatically measures and records any fatigue or failure produced in the process. The plunger is driven by an adjustable eccentric, allowing a variable stroke depth, and hence, an adjustable load. The plunger staff itself telescopes, allowing the plunger to be driven up and down independent of the eccentric. This feature is used in graphing the mattress.

9.3.2 *Ram Head*—A bowling ball properly sectored and joined to closely resemble the form of the average human buttocks. The tester consists of a reciprocating plunger that repeatedly applies a preset deflection to the test mattress, and automatically measures and records any fatigue.

9.4 *Test Procedure*:

9.4.1 Place bedding set on a rigid flat surface in a manner such that the desired location is under the ram head. For a twin-size mattress this shall be midpoint with respect to ends and sides. For a full-, queen-, or king-size mattress this preferably shall be a midpoint with respect to ends and quarter-point with respect to sides. The center line common to the hemispheres of the ram head shall be parallel to the mattress ends.

9.4.2 Raise the ram head (adjust eccentric) to the top of the stroke.

9.4.3 Lower the ram head and shaft until the test load, 230 lbf (1025 N), is obtained. Return ram head to the "up" position, then lower it again until a load of 5 lbf (22 N) is reached.

9.4.4 Adjust static scale to zero. All subsequent readings from the static scale are to be taken to the nearest 1⁄16 in. (1 mm).

9.4.5 Lower the ram head until the test load, 230 lbf (1025 N), is reached. Record the static scale reading for the test load.

9.4.6 Raise the ram head, rotate the eccentric, and adjust the stroke scale to the final static scale reading obtained in 9.4.5.

9.4.7 Rotate the eccentric to the top of the stroke and reset the ram head and shaft so that the pointer is a "0" on the static scale.

9.4.8 Run the test machine under these conditions for 200 cycles at 160 strokes/min.

9.4.9 Stop the machine with the eccentric at the top of the stroke and lower the ram head until the test load, 230 lbf (1025 N), is obtained. Return ram head to the "up" position, then lower it again until a load of 5 lbf (22 N) is reached.

9.4.10 Reset the static scale to zero for the 5-lbf (22-N) deflection.

9.4.11 Lower the ram head and read the load, obtaining readings for each ½ in. (12.7 mm) until the test load, 230 lbf (1025 N), is reached. Record static scale reading for the test load.

9.4.12 Reset the stroke length if necessary (in accordance with 9.4.6) to reach the test load, 230 lbf (1025 N.)

9.4.13 Reset the ram head and shaft so that the pointer is at "0" on the static scale.

9.4.14 Run the test machine under these conditions at 160 strokes/min for a total cumulation of 6000 cycles. (This total includes the 200 cycles of 9.4.8.)

9.4.15 Stop the machine with eccentric at the top of the stroke and lower the ram head until the test load, 230 lbf (1025 N), is obtained. Return ram head to the "up" position, then lower it again until a load of 5 lbf, (22 N) is reached. Read static scale and call the reading" additional dimple."

9.4.16 Repeat 9.4.10-9.4.13.

9.4.17 Repeat 9.4.15, 9.4.10, 9.4.11, 9.4.12, and 9.4.13 (in that order) at 12 500, 25 000, 50 000, 75 000, and 100 000 cumulative cycles—except one should also report under "cumulated dimple" the sum of the "additional dimples" to that point.

9.4.18 Tests shall be planned so they are not interrupted before the 25 000-cycle reading. After this point, the test should be interrupted only at 50 000 and 75 000 intervals, at which time a reading should be taken before the test. When a test is interrupted only at 50 000 and 75 000 intervals, a reading should be taken before the test. When a test is interrupted at any point other than 50 000 and 75 000 intervals, the test load, 230 lbf (1025 N), should be applied to the mattress until the test is resumed. This can be achieved by rotating the eccentric to the bottom of the stroke.

9.5 *Calculation/Results*:

9.5.1 The load deflection curves at 200, 6000, 50 000, and 100 000 cycles shall be plotted on regular graph paper.

9.5.2 Plots shall be prepared using the following:

9.5.2.1 Support firmness versus cycles.

9.5.2.2 Support firmness is the slope in pounds per inch of the upper portion of the force penetration curve and for the purpose is approximated by the force increment between 3 in. (76.2 mm) and 4 in. (101.6 mm) penetration as taken from the data sheet.

9.5.2.3 Cumulative dimple versus cycles.

9.5.2.4 Values of the cumulated or total dimple are taken from the data sheet.

9.5.3 Report the following information:

9.5.3.1 A description of the mattress elements and its construction.

9.5.3.2 The completed data sheet (see Fig. 7).

9.5.3.3 The items listed in 9.5.1-9.5.2.4. Changes in readings from the start of test to finish should be expressed as percentages.

10. Precision and Bias

10.1 Insufficient data is available to properly calculate within- or between-laboratory reproducibility. Following publication of these test methods, it is expected that sufficient laboratories will become involved, round robins will be initiated, and precision and bias statements included in future revisions.

11. Keywords

11.1 boxsprings; firmness; innersprings; mattresses

[6] The sole source of supply of the apparatus known to the committee at this time is L&P Machine Products, 1129 Fairview, Carthage, MO 64836. 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.

TEST #: _____

CORNELL TEST DATA FILE #: _____

MATTRESS: _____ DATE: _____

BOXSPRING: _____

Position: _____ SPM: _____ Load: _____

Cycles	0	200	6000	12500	25000	50000	75000	100000
Stroke (in/mm)	xxxxxx							
	lbs (kg)	lbs (kg)	lbs (kg)	lbs (kg)	lbs (kg)	lbs (kg)	lbs (kg)	lbs (kg)
0.0								
.5" (12.7mm)								
1" (25.4mm)								
1.5" (38.1mm)								
2" (50.8mm)								
2.5" (63.5mm)								
3" (76.2mm)								
3.5" (88.9mm)								
4" (101.6mm)								
4.5" (114.3mm)								
5" (127.0mm)								
5.5" (139.7mm)								
6" (152.4mm)								
6.5" (165.1mm)								
7" (177.8mm)								
Stroke @ 230# (104.33 kg)								
Add. Dimple	xxxxx							
Acc. Dimple	xxxxxx							
Support Firmness *4" - 3"* *(101.6mm - 76.2mm)*		(A)						(B)

Damage:

12500: _____

25000: _____

50000: _____

75000: _____

100000: _____

% Change (A) vs (B)

Tested by: _____

FIG. 7 Data Sheet