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An American National Standard

Standard Test Methods for Evaluating Design and Performance Characteristics of Fitness Equipment[1]

This standard is issued under the fixed designation F2571; 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.

INTRODUCTION

The goal of these tests is to provide reliable and repeatable methods for the evaluation of fitness equipment. The equipment users must recognize, however, that conformance to a standard will not necessarily prevent injuries. Like other physical activities, exercise involving fitness equipment involves the risk of injury, particularly if the equipment is not maintained or used properly.

1. Scope

1.1 These test methods specify procedures and apparatus used for testing and evaluating fitness equipment for compliance to Specification F2276. Both design and operational parameters will be evaluated. Where possible and applicable, accepted test methods from other recognized bodies will be used and referenced.

1.2 It is the intent of this standard to specify test methods for fitness products for use by individuals age 13 and above.

1.3 *Requirements*—Fitness Equipment is to be tested for all of the following parameters:

1.3.1 Stability.
1.3.2 Edge and Corner Sharpness.
1.3.3 Tube Ends and Holes.
1.3.4 Function of Adjustments and Locking Mechanisms.
1.3.5 Handgrip Design and Retention.
1.3.6 Foot Supports.
1.3.7 Load Development and Transmitting Systems.
1.3.8 Chain and Gear Drive Design.
1.3.9 Entrapment Zones and Guarding.
1.3.10 Loading:
1.3.10.1 Intrinsic Loading.
1.3.10.2 Extrinsic Loading.
1.3.10.3 Handlebar Loading.
1.3.10.4 Endurance Loading.
(1) Seat frame endurance loading.
1.3.11 Switch and switch actuation mechanism endurance.
1.3.12 Electrical Guarding.
1.3.13 Maximum Surface Temperature.
1.3.14 Documentation and Warnings Verification.

1.4 The values stated in SI units are to be regarded as the standard. The values 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]
F1749 Specification for Fitness Equipment and Fitness Facility Safety Signage and Labels
F2276 Specification for Fitness Equipment

2.2 *European Standards:*[3]
EN 957-1 Stationary Training Equipment - Part 1: General Safety Requirements and Test Methods

2.3 *UL Standards:*[4]
UL 1439 Standard for Safety Test for Sharpness of Edges on Equipment
UL 1647 Motor-Operated Massage and Exercise Machines
UL 60335 Standard for Safety of Household and Similar Electrical Appliances

[1] These test methods are under the jurisdiction of ASTM Committee F08 on Sports Equipment, Playing Surfaces, and Facilities and are the direct responsibility of Subcommittee F08.30 on Fitness Products.

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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] Available from European Committee for Standardization (CEN), 36 rue de Stassart, B-1050, Brussels, Belgium, http://www.cenorm.be.

[4] Available from Underwriters Laboratories (UL), 333 Pfingsten Rd., Northbrook, IL 60062-2096, http://www.ul.com.

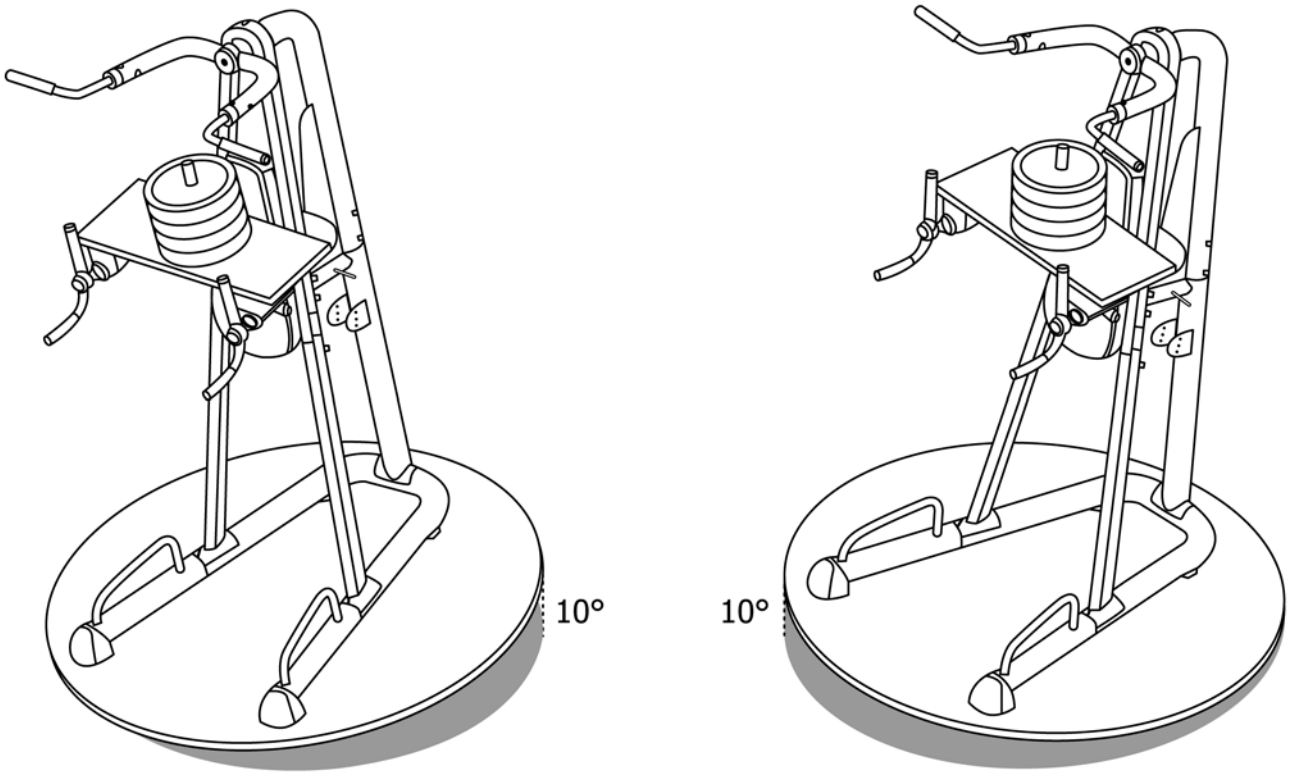

FIG. 1 Tilt Test Illustation Represents Testing the Verticle Knee Raise Station

2.4 *ANSI Standards:*[5]
ANSI B29.1 Precision Power Transmission Roller Chains, Attachments and Sprockets

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *breakage, n*—separation or damage to the structure or components such that they will no longer support the applied load.

3.1.2 *user means, n*—portion of the fitness equipment that the user operates to perform the desired function of the machine. Examples include handles, lifting arms and rollers.

4. Significance and Use

4.1 The purpose of these tests are to provide valid and repeatable methods for the evaluation of fitness equipment assembled and maintained according to the manufacturer's specifications. Use of these test methods in conjunction with Specification F2276 is intended to maximize the reliability of fitness equipment design and reduce the risk of serious injury resulting from design deficiencies.

5. Certification

5.1 These test methods permit self-certification. It is recommended that each manufacturer employ an independent laboratory to evaluate and validate that their designs and test procedures conform and comply to these test methods and Specification F2276.

6. Sample Preparation

6.1 Assemble and adjust the fitness equipment according to the manufacturer's instructions. On machines that are fully assembled, verify according to the manufacturer's instructions that all components are functioning and that they have been adjusted and aligned properly. Unless otherwise stated, the machine must pass the tests without adjustment from this initial condition.

6.2 The individual test methods will describe any variations or modifications that are allowed or are required to the test sample.

7. Test Methods and Procedures

7.1 *Stability:*

7.1.1 Fitness equipment that is designed for the user to maintain balance as part of its function is not required to meet the stability test (that is, a balance board is not tested for stability).

7.1.2 Fitness equipment shall be tested with and without the simulated user load in the orientation that is least stable.

7.1.3 *Apparatus and Set-Up*—Refer to Fig. 1. Place sample on a non-skid surface inclined at 10° in the orientation that is least stable. The sample shall rest on the supporting surface without anchoring unless the installation instructions for the machine require that the sample be anchored to the floor. If this

[5] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

is the case, then anchor the specimen per the manufacturer's recommendations. Determine how the user is placed on the machine to perform the exercise (that is, seated, standing, or prone) and then determine how the user's body weight is distributed onto the user support surfaces. For the simulated use test, a method of applying a steady state load equal to the maximum specified users weight or 100 kg (220 lb), whichever is greater, simulating the user's weight and its distribution in the vertical direction at the point(s) of user contact must be provided. As an example, for a seated user, the user support surface shall be adjusted to the uppermost position (if adjustable) and the center of gravity of the load shall be positioned approximatly 300 mm (12 in.) above the user support surface. Possible methods of providing this load include but are not limited to dead weights.

7.1.4 *Calibration*—Using an angle measuring instrument accurate to within 0.1°, verify the non skid surface is 10 ± 0.5°. Calibrate the load measurement apparatus to confirm accuracy to within ±20 N (4.5 lb) at the specified load of the maximum specified user weight or 100 kg (220 lb), whichever is greater.

7.1.5 *Procedure*—Test the sample as follows:

7.1.5.1 If the equipment has a storage position that is different than the use position, place or adjust the machine into that position. With the tilt surface inclined to 10° verify that the sample does not tip over.

7.1.5.2 Reposition the sample into the use position. With the sample machine [no user load applied] positioned on the tilt surface verify that the sample does not tip over with the tilt surface inclined to 10°.

7.1.5.3 Using an appropriate load apparatus such as dead weights, distribute a vertical load equal to the maximum specified user weight or 100 kg (220 lb), whichever is greater (±5 %), in a non-impact manner to the specimen where the user contacts the machine during normal operation. [If only a portion of the user's body is supported by the machine during operation, the simulated user weight shall be decreased by the appropriate amount.] Raise and support any adjustable devices or other user means to simulate the furthest point in the range of travel so that its orientation would cause the least stable condition as encountered during normal operation as shown in Fig. 1. Verify that the sample does not tip over.

7.1.6 *Pass/Fail Criteria*—In none of the above test conditions shall the sample tip over.

7.1.7 *Precision and Bias*—No information is presented about either the precision or bias of the test for measuring stability since the test result is non-quantitative.

7.2 *Edge Sharpness:*

7.2.1 The purpose of this test is to verify that there are no edges in the accessible area that would constitute a risk of injury. Where there is uncertainty, a sharp-edge tester as specified by UL 1439 is to be employed.

7.2.2 *Apparatus and Set-Up*—The sample shall be set up as described in 6.1.

7.2.3 *Calibration*—Calibrate sharp-edge tester per UL 1439.

7.2.4 *Procedure*—Examine the accessible areas by visual and tactile means to ensure all parts are burr-free, rounded or otherwise insufficiently sharp to constitute a risk of injury. Wherever there may be uncertainty as to the sharpness of an edge, use the edge tester and conduct the test per UL 1439.

7.2.5 *Pass/Fail Criteria*—Use the pass fail criteria of UL 1439 to determine if the sample passes this test.

7.2.6 *Precision and Bias*—No information is presented about either the precision or bias of the test for evaluating sharp edges since the test result is non-quantitative.

7.3 *Corner Sharpness:*

7.3.1 This test is a visual inspection of the sample to ensure that all corners in the accessible areas are radiused or chamfered.

7.3.2 *Apparatus and Set-Up*—The sample shall be set up as described in 6.1.

7.3.3 *Calibration*—No calibration required. Visual inspection only.

7.3.4 *Procedure*—Inspect all corners to verify that the corners have been radiused or chamfered.

7.3.5 *Pass/Fail Criteria*—All corners in the accessible area shall be radiused or chamfered.

7.3.6 *Precision and Bias*—No information is presented about either the precision or bias of the test for evaluating corners since the test result is non-quantitative.

7.4 *Tube Ends and Non-Functional Holes:*

7.4.1 This test is a visual inspection of the unit to ensure that all tube ends and non-functional holes in the accessible area are closed off. Holes smaller than 9.5 mm (0.37 in.) are excluded. Seat or other adjustment holes are exempt from this test.

7.4.2 *Apparatus and Set-Up*—The sample shall be set up as described in 6.1.

7.4.3 *Calibration*—No calibration required. Visual inspection only.

7.4.4 *Procedure*—Inspect all tube ends and surfaces in the accessible area to verify that the ends and non-functional holes are closed off by other components, caps, plugs, or covers.

7.4.5 *Pass/Fail Criteria*—All tube ends in the accessible area shall be closed off or the EN 957-1 test probe shall not be able to be inserted.

7.4.6 *Precision and Bias*—No information is presented about either the precision or bias of the test for evaluating tube end closure since the test result is non-quantitative.

7.5 *Adjustment and Locking Mechanism Function:*

7.5.1 This test is a visual and physical inspection of the adjustment or locking mechanisms, or both, used throughout the sample. The purpose is to ensure that the design prevents inadvertent disengagement, and that the adjustment or locking means do not interfere with the user's operation of the machine.

7.5.2 *Apparatus and Set-Up*—The sample shall be set up as described in 6.1. Obtain instructions or a descriptive explanation of the function of the adjustment or locking systems used on the sample from the manufacturer.

7.5.3 *Calibration*—No calibration required. Visual and function inspection only.

7.5.4 *Procedure:*

7.5.4.1 Inspect each adjustment or locking point on the sample machine and ensure that it positively locks into position and that it cannot be disengaged unless the retention system is

intentionally deactivated. Examples of positive retention devices include, but are not limited to spring activated pins, clamps or eccentric assemblies. Verify that each adjustment and locking mechanism has a functioning positive retention device.

7.5.4.2 Perform the exercise as described in the operation instructions and note the user's body position relative to the adjustment or locking means. At no point during the user's range of movement shall the adjustment or locking means interfere or limit the movement of the user's body. The locking device shall not be inadvertently disengaged during use. During this observation consider the effects of users of different size or body make up.

7.5.5 *Pass/Fail Criteria*—Retention or locking mechanisms that do not function according to the instructions provided by the manufacturer shall fail the test. Retention or locking mechanisms that interfere, or limit the movement of the user during normal operation of the machine shall fail the test.

7.5.6 *Precision and Bias*—No information is presented about either the precision or bias of the test for evaluating adjustment/locking system design and function since the test result is non-quantitative.

7.6 *Handgrip Design and Retention:*

7.6.1 This test is a visual and physical inspection of the handgrips used on the sample. The purpose is to ensure that the handgrip design maintains the user's grip, remains in position and, in the case of rotating handgrips, is retained against unintended movement during use of the machine.

7.6.2 *Apparatus and Set-Up*—The sample shall be set up as described in 6.1. To facilitate this test a separate handgrip/lifting mechanism replicating the system used on the machine can be set up on a separate test stand. A method of applying to the handgrips a steady state force equal to 90 N (20.2 lb) along the longitudinal direction of the grip shall be used. A method of applying moisture to the grip, such as a spray bottle, shall be provided.

7.6.3 *Calibration*—Calibrate the load measurement apparatus to confirm accuracy to within ±1 N (0.2 lb) at 90 N (20.2 lb). Verify that the resolution of the displacement measuring device is 1 mm (0.04 in.).

7.6.4 *Procedure:*

7.6.4.1 Inspect the sample machine and determine if integral handgrip locations are marked on the machine and that they maintain the grip position when dry. Spray the grip surface with water. Allow the water to remain on the surface and absorb for 5 min. Reconfirm that the grip surface maintains the user's relative grip position by grasping the surface and attempting to slide your hand along the surface. An application of increasing force should be noted before your hand moves.

7.6.4.2 Inspect each non integral handgrip on the sample machine and ensure that it is constructed from a slip resistant material and, if the handgrip is designed to rotate, that it is constrained against unintended movement along its longitudinal axis. Examples of slip resistant materials include, but are not limited to, textured plastic, rubber, foam, or vinyl. Repeat the moisture slip test described above to each grip type.

7.6.4.3 Attach or position the loading means to the handgrip with only enough pressure to ensure attachement to the grip. Scribe or mark the specimen to set a measurement reference point. Apply 90 N (20.2 lb) of force to the loading means for 5 min.

7.6.5 *Pass/Fail Criteria*—Handgrips that move by a dimension exceeding 2 mm (0.08 in.) shall fail the test. Handgrips not constructed from slip resistant materials shall fail the test.

7.6.6 *Precision and Bias*—No information is presented about either the precision or bias of the test for evaluating handgrip design and retention since the test result is non-quantitative.

7.7 *Foot Support Design:*

7.7.1 This test is a visual and physical inspection of the foot support used on the sample. The purpose is to ensure that the foot support reduces slippage.

7.7.2 *Apparatus and Set-Up*—The sample shall be set up as described in 6.1. A method of applying moisture to the foot support surface, such as a spray bottle, shall be provided. The evaluator shall be wearing appropriate exercise footwear when conducting this test.

7.7.3 *Calibration*—No calibration required. Visual and function inspection only.

7.7.4 *Procedure*—Inspect the sample machine and determine if the foot supports on the machine are slip resistant when dry. Spray the foot support surface with water. Allow the water to remain on the surface for 5 min. Rest the evaluator's foot on the support surface. Reconfirm that the surface resists slippage by attempting to slide your foot along the surface. An application of increasing force should be noted before your foot moves.

7.7.5 *Pass/Fail Criteria*—Foot supports that do not resist slippage shall fail the test.

7.7.6 *Precision and Bias*—No information is presented about either the precision or bias of the test for evaluating foot support design since the test result is non-quantitative.

7.8 *Load Development and Transmitting Component Testing:*

7.8.1 This test is a visual, physical, and functional inspection of the cables, belts, ropes, or other means, their end fittings and attachment means used on the sample to route the load from the resistance means to the user means to ensure that the design meets the parameters of Specification F2276.

7.8.2 *Apparatus and Set-Up*—The sample shall be set up as described in 6.1. Obtain instructions or a descriptive explanation of the function of the specimen from the manufacturer. Three load transmitting specimens replicating each component that makes up the system installed on the sample including their attachment means shall be provided for a separate loading test. If the sample cannot be replicated in a shortened representive specimen (as in the case of a linkage bar) then the entire sample shall be tested.

7.8.3 *Calibration*—Calibrate the load measurement apparatus to confirm accuracy to within ±50 N (±10 lb).

7.8.4 *Procedure*—Obtain and record from the manufacturer the maximum load amount that the system is subjected to during operation of the sample machine through its recommended range of motion. This should take into account any multiplying effects designed into the system to increase the resistance to the user. Secure the specimen at its end fittings or

attachment points into a tensile loading apparatus capable of loading the specimen with 6× the aforementioned maximum load. The apparatus shall be cabable of recording the maximum load attained during the test. Apply a load to the system equal to 6× the maximum load stated above. Maintain this load for 5 min. If the system fails before attaining the 6× load, record the load attained at failure. If the system attains the load but fails before the 5-min test period has expired record the load and the amount of time at that load. Repeat the test for each of the remaining specimens.

7.8.5 *Pass/Fail Criteria*—If any of the samples fails to attain 6× the maximum load or fails to maintain that load for 5 min then the system shall fail the test.

7.8.6 *Precision and Bias*—No information is presented about either the precision or bias of the test for evaluating belt or rope system design since the test result is non-quantitative.

7.9 *Chain and Gear Drive Design:*

7.9.1 This test is a visual inspection of the unit to ensure that all chain sprockets are guarded or enclosed per ANSI B29.1.

7.9.2 *Apparatus and Set-Up*—The sample shall be set up as described in 6.1. Verify that all guards are properly positioned and secured.

7.9.3 *Calibration*—No calibration required. Visual inspection only.

7.9.4 *Procedure*—Inspect all chain and gear drives and ensure that they are properly guarded per ANSI B29.1.

7.9.5 *Pass/Fail Criteria*—Any portion of the chain or gear drive that fails to meet ANSI B29.1 shall fail this test.

7.9.6 *Precision and Bias*—No information is presented about either the precision or bias of the test for evaluating chain drive design since the test result is non-quantitative.

7.10 *Entrapment Testing:*

7.10.1 This test is to evaluate the risk of injury to the user or to a third party due to inadvertent contact between two or more moving components, or between a moving and a fixed component of the machine. The results of this test determines the adequacy of spacing between components. Methodology entails insertion of the specified probe into the entrapment areas discussed in Specification F2276.

7.10.2 *Apparatus and Set-Up*—The sample shall be set up as described in 6.1 with the pads reinstalled. This test requires probe as specified in EN 957-1, Figure 1 of the 2005 revision . This test also requires sized probes of 9.5 mm (0.37 in.) and 25 mm (0.98 in.) for areas most susceptible to finger injury and 60 mm (2.36 in.) for all other areas. Verify that all guards are properly positioned and secured. An apparatus capable of measuring 4.4 N (1 lb) of pulling force shall be provided.

7.10.3 *Calibration*—Calibrate the load measurement apparatus to confirm accuracy to within ±0.5 N (0.1 lb). Verify that the probe conforms to the dimensions of EN 957-1, Figure 2.

7.10.4 *Procedure*—Refer to Specification F2276 while conducting this test. The evaluator shall place himself/herself on the sample in the operational position and determine and note regions of the sample that are to be evaluated. Areas of concern that are 1800 mm (71 in.) or more above the floor are exempt from this requirement and do not need to be examined further. Areas that are blocked by the user of the equipment throughout the range of motion are also exempt from further examination. The evaluator shall determine, for the area of concern, the portion of the body most likely to be injured and then use the appropriate probe. Insert the probe perpendicular to this area and cycle the machine through one stroke with the minimum resistance selected to verify probe entrapment. Repeat with the full amount of resistance and for the full range of adjustments provided in the machine for its intended use for the area of concern. Pay close attention to the deflection of the machine and its components as this deflection may create new areas of concern. If the probe becomes entrapped, apply a pulling force to remove the probe. Record the force required at the maximum point of entrapment to remove the probe.

7.10.5 *Pass/Fail Criteria*—The probe shall not become entrapped in any mechanical hazard. Entrapment is defined to have occurred if the force to pull out the probe is greater than 4.4 N (1 lb).

7.10.6 *Precision and Bias*—No information is presented about either the precision or bias of the test for evaluating entrapment points because the test result is non-quantitative.

7.11 *Load Testing:*

7.11.1 *Intrinsic Load Testing:*

7.11.1.1 This test is a visual and physical inspection of the specimen to ensure that it shall withstand intrinsic loads applied to the user support surface(s) of the fitness equipment by the user without failure as set forth in Specification F2276.

7.11.1.2 *Apparatus and Set-Up*—The sample shall be set-up as described in 6.1. Note and record whether the specimen is intended for consumer or institutional use. The sample shall not be secured to the floor unless this is required for normal operation of the machine as set forth in the operation instructions provided by the manufacturer. To facilitate this test a separate mechanism replicating the user support sufaces and frame components that are attached to the machine can be set up on a separate test stand.

7.11.1.3 *Calibration*—Calibrate the load measurement apparatus to confirm accuracy to within ±2 % of the maximum load applied.

7.11.1.4 *Procedure*—Determine the location of the load as applied by the maximum specified user weight on the supporting surfaces. Apply the load, as stated in Specification F2276, in the most onerous position of normal use. Distribute this load to the most onerous location of the support and to simulate the actual surface area of normal use (that is, for seats use 300 by 300 mm (11.8 by 11.8 in.), for a foot use 75 by 125 mm (3 by 5 in.)) for a duration of 5 min. Remove the load without disturbing the specimen. Examine the specimen noting the integrity of the user support and the surrounding structures.

7.11.1.5 *Pass/Fail Criteria*—Any user support surface or structure that breaks shall fail this test.

7.11.1.6 *Precision and Bias*—No information is presented about either the precision or bias of the test for intrinsic loading because the test result is non-quantitative.

7.11.2 *Extrinsic Load Testing:*

7.11.2.1 This test is a visual and physical inspection of the specimen to ensure that it shall withstand extrinsic loads applied to the fitness equipment by the user during the operation without failure. This test is to be conducted first on the frame components of the fitness equipment not subjected to

the user's body weight (the value of Wp (in the equation of Section 5 of Specification F2276) is set to zero) and then on the user support surface(s) where Wp is a value greater than zero. An example of a surface subjected to this test would be a seat frame supporting the user that experiences not only the user's body weight but a portion of the load being lifted. It is important that the evaluator understand the operation of the fitness equipment so that the loads applied during this test are done so properly.

7.11.2.2 *Apparatus and Set-Up*—The sample shall be set-up as described in 6.1. Remove the resistance means from the sample. If the sample has upholstered pads installed, they shall be removed for this test. Note and record whether the specimen is intended for consumer or institutional use. It is important that the evaluator understand the operation of the fitness equipment so that the loads are applied properly during the test.

7.11.2.3 *Calibration*—Calibrate the load measurement and application apparatus to confirm accuracy to within ±2 % of the maximum load applied.

7.11.2.4 *Procedure (Frame Components Not Subjected to the User's Body Weight):*

(1) Using the equation of Section 5 of Specification F2276, calculate the loads to be applied during the test with the value of Wp set equal to zero. Block the resistance or user means in a position attained during normal usage. Apply the "block" in the most onerous position of normal usage (the end of a lifting arm, for example). The test apparatus should not restrict free reactionary movement of the machine being tested and should disperse proportionate forces into the test sample in directions simulating actual usage.

(2) Attach a force generating device capable of generating forces specified in the equations of Specification F2276 and a method of measuring this force in place of the resistance means. The location of the reactionary force applied to the user or resistance means and the other components or structures of the fitness equipment shall be substantially the same as would be encountered in normal use circumstances.

(3) Apply a force to the fitness equipment (determined from the calculation in Specification F2276) through the force generating device for a duration of 5 min. Remove the load without disturbing the specimen. Visually inspect the specimen for failure/breakage.

7.11.2.5 *Procedure (Frame Components Subjected to the User's Body Weight):*

(1) Using the equation of Specification F2276, calculate the loads to be applied during the test with the value of Wp set equal to the proportionate amount of the maximum specified user's weight or proportionate amount of 100 kg (220 lb), whichever is greater, experienced during normal usage of the fitness equipment. Mount and secure the load with the center of gravity simulating the user at the location of user contact. Secure the user means in a position attained during normal usage. One end of the system shall be affixed to the user means in the most onerous position of normal usage (the end of a lifting arm, for example). The opposite end of this system shall be affixed to the user support means. The test apparatus should not restrict free reactionary movement of the machine being tested and should disperse proportionate forces into the test sample in directions simulating actual usage. Do not fix the legs of the machine during this test unless the user's manual specifically requires that the legs be fixed for use.

(2) Attach a force generating device capable of generating the forces specified in the equation of Specification F2276 and a method of measuring this force to the user's means so that the load is applied between the user means and the user support surface.

(3) Apply the force to the fitness equipment (determined from the calculation in Specification F2276) through the force generating device for a duration of 5 min. Remove the load without disturbing the specimen. Visually inspect the specimen for failure/breakage.

7.11.2.6 *Pass/Fail Criteria*—Any component or structure that breaks shall fail these tests.

7.11.2.7 *Precision and Bias*—No information is presented about either the precision or bias of the test for extrinsic loading since the test result is non-quantitative.

7.11.3 *Endurance Cycle Testing:*

7.11.3.1 This test is a visual and physical inspection of the specimen to ensure that it shall withstand endurance cycles set forth in Specification F2276 without failure.

7.11.3.2 *Apparatus and Set-Up*—The sample shall be set-up as described in 6.1 with the maximum resistance available for the product. If upholstered pads are installed on the machine, they shall be removed for this test. Note and record whether the specimen is intended for consumer or institutional use. Obtain instruction or a descriptive explanation of the function of the sample fitness equipment from the manufacturer. A non-impact method of cycling the fitness equipment through at least 80% of its normal range of motion, as defined by the manufacturer, shall be provided. If the seat assembly is to be subjected to an endurance load then the preceeding range of motion statement shall be ignored. A method of recording the number of cycles shall be provided. A method of loading the fitness equipment with extrinsic loads experinced during the cycling of the machine shall be provided.

7.11.3.3 *Calibration*—Verify the accuracy of the cycle counting device to ±0.5 % of the full test cycle range.

7.11.3.4 *Procedure:*

(1) Determine from the manufacturer's specifications the maximum range of travel for the machine. Construct and attach to the resistance means of the fitness equipment an apparatus capable of moving the resistance arm through 80 % of this range while loaded with the maximum resistance of the fitness equipment. The testing apparatus shall move the resistance means in the same manner that the user does. For example, if the user contacts the resistance means in two locations then the testing apparatus must do so as well. If during the course of operation the machine receives loading from the user via the resistance means then this shall be considered and figured into the design of the testing apparatus. If the user's body weight is a factor in the loading of the fitness equipment during cyclic operation then the maximum specified users weight or 135 kg (300 lb), whichever is greater, simulating a user, shall be attached to the user support surface at the point of user contact.

(2) The design of the testing apparatus will be unique and different for each product tested. Careful consideration shall be

given by the testing facility as to how the test apparatus is constructed and the testing facility shall communicate with the manufacturer prior to commencing the test to verify that the apparatus functions in a manner similar to how a user would actually use and interface with the fitness equipment.

(3) If the seat assembly is to be subjected to this test, then load the seat in the most onerous position of use with the loads specified in Specification F2276. The seat shall be allowed to deflect "naturally" in response to the applied load. Upon completion of the endurance test, load the seat assembly statically with the load specified in Specification F2276, and repeat the procedure of 7.11.1.

(4) Verify that the counter cycles for each repetition of the machine and then periodically through out the duration of the test. Verify that after each repetition the load at the user means returns to zero prior to the execution of the next repetition. Check this during set up and then again periodically during the test. This may be done with a load cell or simple visual examination of the system. Begin the test. Periodically make and record observations during the test.

(5) If the specimen has multiple stations then replace the shared components, as specified in Specification F2276, and repeat the test on the remaining stations.

(6) Upon completion of the cycles specified in Specification F2276 reinstall the upholstered pads if applicable, and use the machine according to the instructions provided by the manufacturer.

7.11.3.5 *Pass/Fail Criteria*—Fitness equipment or components that fail to attain the minimum number of cycles specified in Specification F2276 shall fail the test. Machines that fail to function as per the operation instructions provided by the manufacturer after completion of the test shall fail the test. In addition, seat assemblies subjected to endurance testing shall pass the static load test at the completion of the endurance test, without failure.

7.11.3.6 *Precision and Bias*—No information is presented about either the precision or bias of the test for endurance cycling since the test result is non-quantitative.

7.11.4 *Handlebar Structural Integrity:*

7.11.4.1 The purpose of this test is to confirm the structural adequacy of the handlebars.

7.11.4.2 *Apparatus and Set-Up*—The sample shall be set-up as described in 6.1. Note and record whether the specimen is intended for consumer or institutional use. For the handlebar vertical load evaluation, supply a means of applying a vertical load as specified in Specification F2276. For handlebar horizontal load evaluation, supply a means of providing a horizontal load equal to the loads specified in Specification F2276. Possible methods of providing that force include, but are not limited to, pneumatic cylinder(s) or dead weights. If necessary, the fitness equipment may be restrained from movement as long as that restraint does not aid the structure of the handlebars.

7.11.4.3 *Calibration*—Verify load application system is calibrated and is accurate to within ±5 % of applied load.

7.11.4.4 *Procedure*—Apply the load specified in Specification F2276 in a vertical direction to a location on the handlebar that generates the greatest load at the weakest structural point. Maintain the load for 5 to 15 s then remove. Repeat this procedure on the same handrail with the horizontal side actuators exerting a force as specified in Specification F2276.

7.11.4.5 *Pass/Fail Criteria*—Handlebars subjected to the above tests shall not break.

7.11.4.6 *Precision and Bias*—No information is presented about either the precision or bias of the test for evaluating structural integrity of the handlebars since the test result is non-quantitative.

7.12 *Switch and Switch Actuation Mechanism Endurance:*

7.12.1 Stop, pause, or end functions for motorized fitness equipment. Note: if several means of stopping exist—for example, Stop switch and Pause switch—each means must be separately tested only if the actuator types are different.

7.12.2 *Apparatus and Set-Up*—Provide a mechanism to repeatedly activate the switch of interest at a rate not to exceed 2 Hz. and to accumulate a count of actuations. Activation force for testing shall be 1.5 × ±10 % the minimum actuating force for the particular switch. For push switches, the activating mechanism can be a simulated finger mounted to an appropriate pneumatic cylinder operating parallel to the line of action of the switch, a test system designed specifically for switch testing (for example, Data Switch Corporation 2100 life tester,[6] having an air cylinder plunger with a rounded simulated finger 17.14 mm (0.675 in.) diameter, 45 durometer rubber, SF-45), or other appropriate actuating means. For non-returning switches, a mechanism must be provided to pull out the switch between actuations, with a force equal to 1.5 × ±10 % the minimum activating force. For lanyard-type, pull-off mechanisms, the switch can be tested as outlined above without the lanyard attached. If this method is employed, a separate lanyard strength test must be conducted by applying a load equal to 5× the maximum activation force of the switch on the lanyard. A means of automatically sensing activation (for example, sensing a "beep" from the control panel internal electronics) will allow monitoring each activation response.

7.12.3 *Calibration*—Verify that the load application system applies 1.5 × ±10 % of the minimum activation force for the switch to be tested. Using appropriate instrumentation, apply the load at a frequency of no more than 2 Hz. Verify activation counter operation for at least 100 cycles. If a lanyard pull is required, the pull force must guarantee activation.

7.12.4 *Procedure*—Actuate the switch being tested with the load application system and confirm that the force applied causes the switch to function. The function of the switch shall be confirmed on every actuation of the switch via a circuit that actuates a counter. A manual check must be made of switch function before and after the full test sequence, and during the automated sequence, some activation-confirming feedback must be observable for each activation. As an alternate to this

[6] The sole source of supply of the apparatus known to the committee at this time is Dataswitch Corporation, 1000 Elm St., Northfield, MN 55057, http://dataswitchcorp.com/. 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.

procedure, if the switch is installed according to the switch manufacturer's recommendations, the switch manufacturer's testing may be used.

7.12.5 *Pass/Fail Criteria*—The switch(es) tested must be functional as described in procedure at the end of the life test requirements for the classification for use as follows: Consumer Fitness Equipment: 1560 actuations without damage or non-functionality; Institutional Fitness Equipment: 46 800 actuations without damage or non-functionality.

7.12.6 *Precision and Bias*—No information is presented about either the precision or bias of the test for evaluating actuator endurance because the test result is non-quantitative.

7.13 *Electrical Guarding:*

7.13.1 The purpose of this test is to verify that the guarding of electrical components of fitness equipment prevent inadvertent contact with hazardous electrical elements.

7.13.2 *Apparatus and Set-Up*—The manufacturer and testing facility shall determine and agree upon which UL standard the product will be tested to—UL 1647 or UL 60335. The sample shall be set up as described in 6.1 and as further required to complete the testing of UL 1647 or UL 60335.

7.13.3 *Calibration*—Calibration shall be set up to meet the requirements of the standard chosen.

7.13.4 *Procedure*—All applicable procedures in the chosen UL standard shall be followed.

7.13.5 *Pass/Fail Criteria*—Use the pass fail criteria of the chosen UL standard to determine if the sample passes this test.

7.13.6 *Precision and Bias*—No information is presented about either the precision or bias of the test for evaluating the guarding of electrical components since the test result is non-quantitative.

7.14 *Maximum Surface Temperature:*

7.14.1 The purpose of this test is to verify that any accessible surface of the fitness equipment does not exceed the maximum allowable temperature when used according to the manufacturer recommendations.

7.14.2 *Apparatus and Set-Up*—The sample shall be set up as described in 6.1.

7.14.3 *Calibration*—Calibrate a surface temperature measuring device to an accuracy of ±2ºC or better.

7.14.4 *Procedure*—Operate the equipment at the maximum allowed rate under normal use as described by the manufacturer. Mechanical devices can be used to manipulate the equipment simulating a normal continuous use condition for a minimum of twenty minutes or as recommended by the manufacturer, whichever is greater. Measure the surface temperature of all accessible areas to determine the maximum temperature reached during the test period.

7.14.5 *Pass/Fail Criteria*—The fitness equipment shall fail if any surface exceeds the maximum allowable temperature of 60ºC (140ºF) for metal and 85ºC (185ºF) for plastic and other non-metallic surfaces during the test period.

7.14.6 *Precision and Bias*—No information is presented about either the precision or bias of the test for temperature rise.

7.15 *Documentation and Warnings:*

7.15.1 This test is a confirmation that the documentation, markings and warnings accompanying and affixed to the sample meet the requirements set forth in Specification F2276 and Specification F1749.

7.15.2 *Apparatus and Set-Up*—The sample shall be set up as described in 6.1. Obtain all documentation for the sample from the manufacturer.

7.15.3 *Calibration*—No calibration is required. This is a visual test only.

7.15.4 *Procedure*—Examine the documentation provided with the sample. Verify that the documentation conforms to Specification F2276. Examine each of the warning labels affixed to the sample. Verify that the labels conform to Specifications F2276 and F1749. Examine the product markings and verify that they conform to the requirements of Specification F2276.

7.15.5 *Pass/Fail Criteria*—Documentation, warnings and markings must conform to requirements of Specifications F2276 and F1749.

7.15.6 *Precision and Bias*—No information is presented about either the precision or bias of the test for documentation, markings, and warnings compliance because the test result is non-quantitative.

8. Report

8.1 *Record of Tests*—Maintain complete test records and test summary reports for all testing whether performed by the manufacturer or an independent laboratory. The records can be stored on paper, electronically, or on photographs, or on a combination thereof. A copy of the test summary must be kept by the laboratory that performed the test for a minimum of five years from the date of the test and by the manufacturer for a minimum of five years past the end of production of the model tested. The summary shall include the signature of the technician(s) performing the tests and a management representative of the laboratory performing the test. The test summary shall include the following information:

8.1.1 Manufacturer's name and location.

8.1.2 Information provided by the manufacturer to accurately identify the model or configuration and the serial number or identification of the specific unit provided to the testing agency.

8.1.3 Dates over which the tests were conducted.

8.1.4 Name and location of the testing laboratory, if different from the manufacturer.

8.1.5 Summary and results of each test performed including method and apparatus used. This shall include what the desired requirement was and whether the test sample met that parameter or failed. If the test requires a specific number of cycles to be met, then the report must include the number of cycles actually conducted. If the sample fails to meet a parameter, then that failure must be noted in clear and accurate terms to enable a reader of the report to understand at a later date what transpired.

9. Keywords

9.1 fitness equipment