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Standard Test Methods for Evaluating Design and Performance Characteristics of Stationary Upright and Recumbent Exercise Bicycles and Upper Body Ergometers[1]

This standard is issued under the fixed designation F3023; 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 test methods is to provide reliable and repeatable methods for the evaluation of stationary exercise bicycles and upper body ergometers.

The equipment user must recognize, however, that a standard alone will not necessarily prevent injuries. Like other physical activities, exercise involving stationary upright and recumbent exercise bicycles and upper body ergometers involves the risk of injury, particularly if the equipment is used improperly or not properly maintained. In addition, users with physical limitations should seek medical advice and instruction from the fitness facility prior to using this equipment. Certain physical conditions or limitations may preclude some persons from using this equipment properly and without increasing the risk of serious injury.

1. Scope

1.1 These test methods specify procedures and equipment used for testing and evaluating stationary exercise bicycles and crank training equipment (machines) for compliance to Specification F1250. Both design and operational parameters will be evaluated. Where possible and applicable, accepted test methods from other recognized bodies will be used and referenced. In case of a conflict between this document and Specification F1250, Specification F1250 takes precedence.

1.2 *Requirements*—Stationary exercise bicycles and crank training equipment are to be tested for the parameters specified in Specification F2276 and Test Methods F2571 and the following parameters unique to this equipment:

1.2.1 Seat post construction and loading
1.2.2 Handlebar construction and loading
1.2.3 Pedal construction and loading
1.2.4 Crank Arm and Enclosure Entrapment
1.2.5 Seat back support loading
1.2.6 Stability
1.2.7 Direct Drive Exercise Bicycle Pedal Endurance
1.2.8 Warnings
1.2.9 Documentation

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

1.4 *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]

F1250 Specification for Stationary Upright and Recumbent Exercise Bicycles and Upper Body Ergometers
F1749 Specification for Fitness Equipment and Fitness Facility Safety Signage and Labels
F2276 Specification for Fitness Equipment
F2571 Test Methods for Evaluating Design and Performance Characteristics of Fitness Equipment

2.2 *European Standards:*[3]

EN 957-1 Stationary Training Equipment — Part 1: General Safety Requirements and Test Methods

[1] These test methods are under the jurisdiction of ASTM Committee F08 on Sports Equipment, Playing Surfaces, and Facilities and is 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), Avenue Marnix 17, B-1000, Brussels, Belgium, http://www.cen.eu.

3. Terminology

3.1 *Definitions:* For definitions applicable to this standard see Specification F1250.

4. Significance and Use

4.1 The purpose of these test methods is to provide reliable and repeatable test methods for the evaluation of stationary exercise bicycles and crank training equipment assembled and maintained according to the manufacturer's specifications. Use of these test methods in conjunction Specification F1250 is intended to ensure appropriate performance and reliability of said equipment and reduce the risk of serious injury 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 test procedures and methodologies conform and comply with these test methods and Specification F1250.

6. Sample Preparations

6.1 Assemble and adjust the machine on a horizontal surface according to the manufacturer's instructions. For 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 following tests without adjustment from this initial condition. Apply power to, if required, or use the machine and verify that the unit functions properly.

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

6.3 Unless noted, the machine shall function as intended by the manufacturer after the completion of the tests.

7. Test Methods and Procedures

7.1 In addition to the tests specified in Test Methods F2571, stationary exercise bicycles and crank training equipment shall be evaluated as follows:

7.1.1 *Design and Construction:*

7.1.1.1 *Seat Post*—The purpose of this test is to evaluate the construction and retention of the seat post.

(1) Apparatus and Set Up—The sample shall be set up as described in 6.1.

(2) Calibration—Verify that the measurement device is properly calibrated and has a resolution of 1 mm (0.04 in.).

(3) Procedure—Remove the seat post from the machine. Measure the largest cross sectional dimension of the seat post. Multiply this number by 1.5 (d). Inspect the seat post and verify that there is a mark on the seat post indicating the minimum insertion depth at dimension d calculated above. Verify that the seat post is retained in any of its adjustment positions by a clamp, pin or similar means. Verify that the mark defined above is even with the top of or below the top of the seat adjustment sleeve tube when the seat is adjusted into its uppermost position, or that the design is such that the seat post cannot be removed from the machine without the use of tools.

(4) Pass/Fail Criteria—If the above criteria are not met the sample shall fail the test.

(5) Precision and Bias—No information is presented about either the precision or bias of this test since the test result is non-quantitative.

(a) Precision—The precision of this test method has not been determined.

(b) Bias—The bias of this test method includes quantitative estimates of the uncertainties of the measuring devices, the calibrations of testing equipment, and the skill of the operators. At this time, the statements on bias should be limited to documented performance of particular laboratories.

7.1.1.2 *Seat Support*—The purpose of this test is to evaluate the presence of a seat support plate or structure.

(1) Apparatus and Set Up—The sample shall be set up as described in 6.1.

(2) Calibration—Visual verification only.

(3) Procedure—Remove the seat and seat post from the machine. Verify that there is a seat support plate or structure present between the underside of the seat and the top end of the seat post.

(4) Pass/Fail Criteria—If there is no seat supporting structure present, the sample shall fail the test.

(5) Precision and Bias—No information presented about either the precision or bias of this test since the result is non-quantitative.

7.1.1.3 *Handlebar Stem Insertion*—The purpose of this test is to verify the existence of a mark on the handlebar post indicating the minimum insertion depth.

(1) Apparatus and Set Up—The sample shall be set up as described in 6.1.

(2) Calibration—Verify that the measurement device is properly calibrated and has a resolution of 1 mm (0.04 in.).

(3) Procedure—Remove or adjust the handlebar assembly to its uppermost position and visually verify the presence of a mark on the handlebar stem indicating the minimum insertion depth. Verify that this mark is 63.5 mm (2.5 in.) from the end of the handlebar stem.

(4) Pass/Fail Criteria—The mark indicated above must be present at 63.5 mm (2.5 in.) from the end of the handlebar stem or the design must be such that the handlebar assembly cannot be removed from the machine without the use of tools.

(5) Precision and Bias:

(a) Precision—The precision of this test method has not been determined.

(b) Bias—The bias of this test method includes quantitative estimates of the uncertainties of the measuring devices, the calibrations of testing equipment, and the skill of the operators. At this time, the statements on bias should be limited to documented performance of particular laboratories.

7.1.1.4 *Pedal Design*—The purpose of this test is to evaluate the pedal construction.

(1) Apparatus and Set Up—The sample shall be set up as described in 6.1.

(2) Calibration—Verify that the measurement device is properly calibrated and has a resolution of 1 mm (0.04 in.).

(3) Procedure—Inspect each pedal and verify that the pedals contain a mark indicating right and left as referenced from the user position. Verify that there is a slip resistant surface or structure (ribs or "teeth") on the surface of the pedal contacted by the user during use. For hand crank equipment, verify the presence of the right and left markings and the presence of a slip resistant gripping surface. Position the foot pedal into its lowest travel position relative to the floor. Measure the gap between the pedal and the floor.

(4) Pass/Fail Criteria—If the criteria described above is not present the sample shall fail the test. The dimension measured above shall be 60 ± 1 mm (2.36 ± 0.040 in.) or greater.

(5) Precision and Bias:

(a) Precision—The precision of this test method has not been determined.

(b) Bias—The bias of this test method includes quantitative estimates of the uncertainties of the measuring devices, the calibrations of testing equipment, and the skill of the operators. At this time, the statements on bias should be limited to documented performance of particular laboratories.

7.1.1.5 *Crank Arm and Enclosure Entrapment*—The purpose of this test is to evaluate entrapment at the interface/margins of the crank arm and the center shroud or enclosure.

(1) Apparatus and Set Up—The sample shall be set up as described in 6.1. This test requires probe as specified in EN 957-1 Figure 1 of the 2005 revision. 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.

(2) 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.

(3) Procedure—Insert the test finger probe parallel to the axis of rotation (within ±5°) of the crank arm along the surface of the crank arm until it contacts the center enclosure. Rotate the crank arm completely (in both directions) and insure that the finger probe does not become entrapped. If the rotation of the crank arm pushes the probe out of the way then entrapment does not occur.

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

(5) Precision and Bias:

(a) Precision—The precision of this test method has not been determined.

(b) Bias—The bias of this test method includes quantitative estimates of the uncertainties of the measuring devices, the calibrations of testing equipment, and the skill of the operators. At this time, the statements on bias should be limited to documented performance of particular laboratories.

7.1.2 *Static Loading*—The purpose of this test is to evaluate the static structural integrity of the seat, handlebars, and pedals as set for in Specifications F1250 and F2276.

7.1.2.1 *Recumbent Exercise Bicycle Handlebars*—The purpose of this test is to confirm structural integrity of the handlebars.

(1) Apparatus and Set Up—The sample shall be set up as described in 6.1. Possible methods of provided the force for this test include, but are not limited to, pneumatic cylinder(s) or dead weights. If necessary, the machine may be restrained from movement as long as that restraint does not aid the structure of the structure being tested.

(2) Calibration—Verify the load application system is calibrated and is accurate to within ±2 % of applied load.

(3) Procedure—Apply the static load to the weakest structural point of the handlebars in the vertical direction. Maintain the load for five minutes, and then remove. Visually inspect for indications of breakage. If applying the load to only one handlebar (as allowed in Specification F1250) apply ½ the load stated in Specification F1250 vertically for 5 min and then remove.

(4) Pass/Fail Criteria—The handlebar shall not break.

(5) Precision and Bias—No information is presented about either the precision or bias of this test since the test result is non-quantitative.

7.1.2.2 *Exercise Bicycle Handlebar Horizontal Axis Torque Evaluation*—The purpose of this test is to confirm the horizontal torque integrity of the handlebars.

(1) Apparatus and Set Up—The sample shall be set up as described in 6.1 with the handlebars adjusted into their uppermost adjustment position. Possible methods of providing the force for this test include, but are not limited to, pneumatic cylinder(s) or dead weights. If necessary, the machine may be restrained from movement as long as that restraint does not aid the structure of the structure being tested. Clamp a 150 mm (5.9 in.) long reference bar to the handle bar then measure and record its height to the floor.

(2) Calibration—Verify the load application system is calibrated and is accurate to within ±5 % of applied load. Verify that the measurement device is properly calibrated and has a resolution of 1 mm (0.04 in.).

(3) Procedure—Apply the torque about the horizontal axis of the handlebar. Maintain the load for five minutes, and then remove. Re-measure the height from the reference bar to the floor.

(4) Pass/Fail Criteria—The reference bar shall not have moved by more than the resolution of the measuring device.

(5) Precision and Bias—No information is presented about either the precision or bias of this test since the test result is non-quantitative.

7.1.2.3 *Exercise Bicycle Handlebar Vertical Axis Torque Evaluation*—The purpose of this test is to confirm the vertical torque integrity of the handlebars.

(1) Apparatus and Set Up—The sample shall be set up as described in 6.1 with the handlebars adjusted into their uppermost adjustment position. Possible methods of providing the force for this test include, but are not limited to, pneumatic cylinder(s) or dead weights. If necessary, the machine may be restrained from movement as long as that restraint does not aid the structure of the structure being tested. Clamp a 150 mm (5.9 in.) long reference bar to the handle bar stem then measure and record its distance to a vertical reference surface such as a wall.

(2) Calibration—Verify the load application system is calibrated and is accurate within ±2 % of applied load. Verify that the measurement device is properly calibrated and has a resolution of 1 mm (0.04 in.).

(3) Procedure—Apply the torque about the vertical axis of the handlebar. Maintain the load for five minutes, and then remove. Re-measure the distance from the reference bar to the wall or reference surface.

(4) Pass/Fail Criteria—The reference bar shall not have moved by more than the resolution of the measuring device.

(5) Precision and Bias—No information is presented about either the precision or bias of this test since the test result is non-quantitative.

7.1.2.4 *Seat Back Supports*—The purpose of this test is to evaluate the static structural integrity of the seat back supports.

(1) Apparatus and Set Up—The sample shall be setup as described in 6.1. Supply a means of providing a steady state load (pneumatic cylinder(s), weights, etc.) to the back rest. Load is to be applied on a 300 by 300 mm (11.8 by 11.8 in.) square area with its center located 500 mm (19.7 in.) above the seating surface or 50 mm (1.98 in.) below the upper edge of the seat back if the seat is less than 560 mm (22 in.) tall. Determine and record the vertical dimension, *h*, to the point of application of the load.

(2) Calibration—Verify the load application system is calibrated and is accurate to within ±2 % of the applied load.

(3) Procedure—With the back support set up as described above, apply the load horizontally and maintain it for five minutes.

(4) Pass/Fail Criteria—The seat back support and supporting structures shall not break or deform permanently by more than 10 % of dimension *h* horizontally.

(5) Precision and Bias—No information is presented about either the precision or bias of this test since the test result is non-quantitative.

7.1.2.5 *Seat Deflection or Tilt Evaluation*—The purpose of this test is to evaluate the tilt requirements of the seat assembly.

(1) Apparatus and Set Up—The sample shall be set up as described in 6.1 with the seat adjusted into its uppermost adjustment position. Possible methods of providing the force for this test include, but are not limited to, pneumatic cylinder(s) or dead weights. If necessary, the machine may be restrained from movement as long as that restraint does not aid the structure of the structure being tested. Clamp a load receiving plate 50 by 50 mm (1.97 by 1.97 in.) flush with the front (and then the rear) of the seat. Zero and measure the angle of the loading plate as referenced to the floor.

(2) Calibration—Verify the load application system is calibrated and is accurate to within ±2 % of applied load. Verify that the measurement device is properly calibrated and has a resolution of ½ °.

(3) Procedure—Apply an upward vertical load to the loading plate. Maintain the load for five minutes, and then remove. Re-measure the angle of the loading plate with respect to the floor. Repeat the test with a downward load applied to the loading plate. Repeat both tests at the rear of the seat.

(4) Pass/Fail Criteria—The loading plate shall not have moved by more than 2 ± ½ ° for any of the above tests.

(5) Precision and Bias:

(a) Precision—The precision of this test method has not been determined.

(b) Bias—The bias of this test method includes quantitative estimates of the uncertainties of the measuring devices, the calibrations of testing equipment, and the skill of the operators. At this time, the statements on bias should be limited to documented performance of particular laboratories.

7.1.3 *Stability:*

7.1.3.1 *Apparatus and Set Up*—Assemble and set up the machine per 6.1. A method of applying a steady state load equal to the maximum specified users weight or 100 kg (220 lb), whichever is greater, in the vertical direction must be provided. The seat post shall be adjusted to its uppermost position. A "load mounting plate" 300 by 300 mm (11.8 by 11.8 in.) shall then be positioned 150 mm (5.9 in.) above the seat post and then clamped to it. Possible methods of providing this load include but are not limited to pneumatics or dead weights. A load measuring device accurate to ±2 N (0.45 lb) is required to perform the test.

7.1.3.2 *Calibration*—Calibrate, or verify calibration of, the load measurement apparatus to confirm accuracy to within ±2 N (0.45 lb).

7.1.3.3 *Procedure*—Test the sample as follows:

(1) With the machine set up as described above, apply the simulated user weight load onto the loading surface defined in 7.1.3.1

(2) A pull test is to be conducted in the forward, rearward, and side directions. Attach the load measuring device and a pulling apparatus or strap to the seat frame at a point 760 mm (29.9 in.) above the floor.

(3) In the forward direction, apply a force of 178 ± 2 N (40 ± 0.5 lb) for the duration of 10 s.

(4) In the rearward direction, apply a force of 111 ± 2 N (25 ± 0.5 lb) for the duration of 10 s.

(5) In each of the side directions, apply a force of 89 ± 2 N (20 ± 0.5 lb) for the duration of 10 s.

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

7.1.3.5 *Precision and Bias*—No information is presented about either the precision or bias of this test since the test result is non-quantitative.

7.1.4 *Direct Drive Bicycle Pedal Endurance:*

7.1.4.1 *Apparatus and Set Up*—The sample may be set up as described in 6.1 with the pedal/crank arm assemblies "blocked" to prevent rotation and set at the 12 o'clock / 6 o'clock positions or the pedal/crank arm assembly may be removed from the exercise bicycle and set up in a test stand. The load to the pedal shall be applied at the center of the pedal vertically. The load shall be applied against a loading "plate" 50 by 50 mm (1.98 by 1.98 in.) that is affixed to the pedal. Pneumatic cylinders are an efficient way to apply the required load. Verify that the applied load returns to zero after each loading cycle.

7.1.4.2 *Calibration*—Verify that the applied load is constant at 900 N (202 lb) ±2 %. Verify the accuracy of the counting device to ±0.05 % of the full cycle range of the device.

7.1.4.3 *Procedure*—With the pedal/crank arm assembly set up as described above, apply the load cyclically for 1 000 000 cycles.

7.1.4.4 *Pass/Fail Criteria*—The pedal or crank arm assembly shall not fail as a result of this test.

7.1.4.5 *Precision and Bias*—No information is presented about either the precision or bias of this test since the test result is non-quantitative.

7.1.5 *Warning Label Compliance*—This test is a visual confirmation that the test unit is properly labeled.

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

7.1.5.2 *Calibration*—No calibration required.

7.1.5.3 *Procedure*—Inspect the unit for warning labels and tags. Ensure that the labels are firmly affixed to the unit and cannot be readily removed.

7.1.5.4 *Pass/Fail Criteria*—Labeling must conform to the requirements of Specifications F1250 and F1749.

7.1.5.5 *Precision and Bias*—No information is presented about either the precision or bias of the test for warning label compliance since the test result is non-quantitative.

7.1.6 *Documentation*—This test is a confirmation that the documentation accompanying the unit meets requirements and the marking on the unit meets the requirements of Specifications F1250 and F2276.

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

7.1.6.2 *Calibration*—No calibrations required.

7.1.6.3 *Procedure*—Examine the documentation provided with the unit. Verify that the documentation is legible. Examine the marking on the exercise bicycle and verify it conforms to the requirements of Specifications F1250 and F2276.

7.1.6.4 *Pass/Fail Criteria*—Documentation must conform to requirements of Specifications F1250 and F2276.

7.1.6.5 *Precision and Bias*—No information is presented about either the precision or bias of this test for documentation compliance since the test 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 combinations 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 the 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 configuration of, and specific unit provided to, the testing agency,

8.1.3 Dates over which the tests were conducted, and

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 trainer 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 crank training equipment; ergometer; exercise bike; fitness; recumbent exercise bike

RELATED MATERIAL

EN 957–5 Stationary Training Equipment — Part 5: Stationary Exercise Bicycles and Upper Body Crank Equipment, Additional Specific Safety Requirements and Test Methods