



United States Golf Association and R&A Rules Limited

ACTUAL LAUNCH CONDITIONS
OVERALL DISTANCE AND SYMMETRY
TEST PROCEDURE
(PHASE II)

USGA-TPX3006

Revision 2.0.0

February 28, 2011

This document details the procedure for evaluating the conformance of golf balls using Actual Launch Conditions and the Indoor Test Range.

Change Record

<i>Page</i>	<i>Section</i>	<i>Date</i>	<i>Details</i>
<i>NOTE</i>		2/28/2011	<i>The referenced changes have been made to reflect current and facilitate future changes made in testing practices to increase test efficiency, as well as equipment and software upgrades. No changes have been made in the criteria for conformance determination.</i>
Title		2/28/2011	Updated to include document number and revision date
Various	2.1	2/28/2011	Removed reference to ITR software
4	6.1	2/28/2011	Updated to reflect change in ball labeling wherein only balls 1 and 24 include the USGA lot number
Various		2/28/2011	Changed reference from calibration balls to control balls
Various		2/28/2011	Removed requirement for which number ball is used in tests
6	6.10	2/28/2011	Added sections describing repeatability tests that are part of current quality assurance practice
Title	N/A	6/1/04	The Royal and Ancient Golf Club of St. Andrews changed to R&A Rules Limited
1	N/A	6/1/04	Record of changes added
1	N/A	6/1/04	The Royal and Ancient Golf Club of St. Andrews changed to R&A Rules Limited
2	1.2	6/1/04	The Royal and Ancient Golf Club of St. Andrews changed to R&A Rules Limited
2	2.1	6/1/04	The Indoor Test Range (ITR) Technical Description and Operation Manual, changed to Version 2
3	5.2	6/1/04	Number of balls to be identified and marked increased from 6 to 12
3	5.5	6/1/04	Mechanical golfer calibration ball identified as “USGA/R&A Calibration”
3	Table 5.5	6/1/04	Description of reference ball speed included
4	5.8	6/1/04	Increased repeat of steps to reflect increase in number of ball samples used for testing
4	6.1	6/1/04	Expand allowable temperature range for aerodynamic testing from $\pm 2^{\circ}\text{F}$ to $\pm 3^{\circ}\text{F}$
4	6.2	6/1/04	Number of balls to be measured increased from 6 to 12
4	6.5	6/1/04	The allowable range of the expected nominal value of the C_L and C_D for the calibration ball is set at $\pm 5\%$
4	6.6	6/1/04	Number of balls to be tested increased from 6 to 12
4	6.7	6/1/04	Number of balls to be tested increased from 6 to 12
4	6.8	6/1/04	Number of ITR test settings set to 15
5	6.9	6/1/04	Reference to The Indoor Test Range (ITR) Technical Description and Operation Manual, changed to Version 2
6	7.1	6/1/04	Reference to The Indoor Test Range (ITR) Technical Description and Operation Manual, changed to Version 2
6	7.3.4	6/1/04	Notification to manufacturer and request for corrective action changed from “should” to “shall”
7	App. A	6/1/04	Appendix detailing Test club and ball specifications added

United States Golf Association and R&A Rules Limited

ACTUAL LAUNCH CONDITIONS OVERALL DISTANCE AND SYMMETRY TEST PROCEDURE (PHASE II)

1. Scope

- 1.1 This method covers the procedure for performing the overall distance and symmetry conformance tests for golf balls as administered by the United States Golf Association (USGA).
- 1.2 The results of the conformance tests are used by R&A Rules Limited (R&A) and the USGA in determining conformity of the golf balls to the Rules of Golf.
- 1.3 The values stated in imperial units are to be regarded as standard. The values stated in SI units are for information only.

2. Applicable Documents

- 2.1 USGA and R&A documents:
 - Rules of Golf
 - List of Conforming Golf Balls
 - The Indoor Test Range (ITR) Technical Description and Operation Manual

3. Summary of Method

- 3.1 Using equipment at the USGA Research and Test Center, currently referred to as the Indoor Test Range (ITR), the aerodynamic properties of a sample lot of golf balls are

completely characterized by the coefficient of lift (C_L), and coefficient of drag (C_D).

- 3.2 Using the aerodynamic coefficients, the overall distance (carry plus roll) of a sample lot, as well as its spherical symmetry, is determined for a specific combination of launch conditions (ball speed, spin rate and launch angle) as determined by a mechanical golfer.

4. Significance

- 4.1 This method is used to determine the overall distance and symmetry of golf balls for a given set of launch conditions. The data obtained from this method is used to ascertain the conformance of the golf balls to the Overall Distance and Symmetry Standards as stated in the Rules of Golf (Appendix III).

The overall distance of the ball shall not be greater than **317.0** yards. A maximum test tolerance of **3.0** yards is associated with this test.

In addition, the ball must not be designed, manufactured or intentionally modified to have properties that differ from those of a spherically symmetric ball. A spherically symmetric ball shall not exhibit statistically significant differences in carry distance greater than **4.0** yards or in flight time of more than **0.40** seconds regardless of which

axis the ball is spinning about when launched.

- 4.2 Letters are sent to the golf ball manufacturers advising of those brands of golf balls that do not conform to the Overall Distance or Symmetry Standards or which fall within the test tolerances.
- 4.3 Only those balls that have already passed the conformance tests for Weight, Size, and Initial Velocity will be tested for conformance to the Overall Distance and Symmetry Standards.
- 4.4 Golf balls that conform to the Weight, Size, Initial Velocity, Symmetry, and Overall Distance Standards are included in the List of Conforming Golf Balls, published monthly by the USGA and R&A.
- 4.5 Intermediate screening procedures may be used to determine ball conformance and increase testing efficiency. However, no ball will be ruled non-conforming unless it has been tested according to this protocol.

5. Determination of Launch Conditions

- 5.1 At this point in the conformance testing process the balls should be separated into two individual boxes labeled Dozen 1 and Dozen 2. Each ball should have an individual ball number. Verify that the markings on the balls match those on the boxes and that balls numbered 1 through 12 are contained in Dozen 1 and that balls numbered 13 through 24 are contained in Dozen 2. As balls are assigned to boxes randomly, either box may be selected for testing.
- 5.2 Identify and mark the seam and pole locations on twelve balls from the selected box. (Figure 5.2)
- 5.3 Once the balls are properly marked, they should be stored in the incubator at a temperature of 75.0±1.0°F (23.9°C) for at least 3 hours.

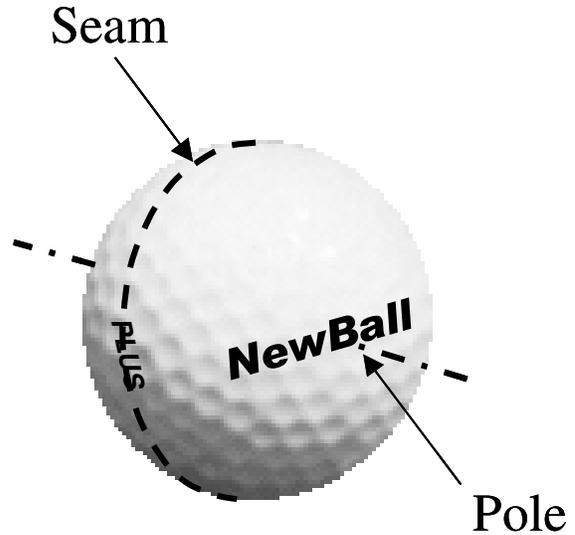


Figure 5.1 - Ball Pole and Seam Marks

- 5.4 Ensure good mechanical operation and proper warm-up of the mechanical golfer.
- 5.5 Verify calibration of the mechanical golfer by hitting six “USGA/R&A Calibration” balls (hereafter referred to as “Control Balls”) and measuring the launch conditions.
 - 5.5.1 If the average value of the launch conditions falls within the ranges specified in Table 5.5 then proceed to step 5.6.
 - 5.5.2 If the average value of any of the launch conditions falls outside of the ranges specified in Table 5.5 then the mechanical golfer setup must be any special causes must be identified and corrected and Section 5 repeated.

Table 5.5 - Mechanical Golfer Calibration Conditions

Launch Condition	Mean	Acceptable Range
Angle	10°	±0.5°
Spin	42 rps	+2.0 rps
Swing Speed	120 mph	+0.5 mph
Ball Speed	256 fps	Reference*

* The reference ball speed of 256 fps represents the speed after initial aging to a near steady-state condition.

- 5.6 Place the first ball of the sample lot on the tee and strike it so that it is launched to produce a back spin about an axis perpendicular to line drawn between the poles or along the seam as identified in step 5.1.
- 5.7 Measure and record the launch angle, spin rate and velocity for the shot.
- 5.8 Repeat steps 5.6 through 5.7 for the remaining golf balls.
- 5.9 Calculate the means of the launch angle, back spin and speed values measured in steps 5.7 and 5.8. These are the launch conditions for the sample lot that will be used to determine conformance to the Overall Distance and Symmetry Standards.

(To maximize testing efficiency multiple sample lots may be tested during a single session. When multiple lots are tested, monitoring of the mechanical golfer using control balls, step 5.5, should also be performed at the conclusion of testing.)

6. Determination of Aerodynamic Properties

- 6.1 Ensure that the room temperature is kept at $75 \pm 3^\circ\text{F}$ (23.9°C).
- 6.2 Measure the outside diameter of balls numbered 13 through 24 along three axes, one from pole to pole and in two orthogonal directions across the seam (equator), and calculate the average ball diameter.
- 6.3 Ensure good mechanical operation and proper warm-up of the test equipment.
- 6.4 Set the launcher wheel speeds to produce the desired ball velocity and spin rate described in the ITR Manual.

- 6.5 Fire six control balls down the range. After each shot verify that data was obtained from each measurement station..

- 6.6 Verify that the predicted carry, flight time, and overall distance of the control ball are within statistical limits. If the control ball performance is not within these limits, then any special causes must be identified and corrected, and section six repeated.

- 6.7 Repeat 6.5 using balls of the test lot, in ascending numerical order, with the balls launched in the "poles horizontal" (PH) orientation (i.e. such that they spin about an axis described by a line that would pass through the poles of the ball and that would lie in horizontal plane and be perpendicular to the direction of flight, Figure 6.6.)

- 6.8 Repeat step 6.6 using balls of the test lot, in ascending numerical order, with the balls launched such that they spin about the axis described by a line that would pass through the seam (equator) of the ball and that would lie in horizontal plane and be perpendicular to the direction of flight (Figure 6.7.) This orientation is referred to as "pole-over-pole" (PP).

(To maximize testing efficiency multiple sample lots may be tested during a single session.)

- 6.8 Repeat steps 6.4 through 6.7 until data has been obtained at each of the full set of test settings (i.e. launch velocity and spin rate) described in the ITR Manual.

(Note: The USGA and R&A reserve the right to change the settings at any time to increase the accuracy and/or efficiency of the test.)

- 6.9 From the data collected in steps 6.5 through 6.8, calculate the coefficients of lift (C_L) and drag (C_D) for the control ball and both orientations of all tested sample lots.

- 6.10 Repeat sections 6.7 through 6.9 for the first test lot selected. Verify that the

performance prediction repeatability of this ball is within acceptable limits.

6.10.2 If the repeatability performance is not within acceptable limits, then any special causes must be identified and corrected. If it is determined that such cause is related to the operation or function of the ITR system, then step 6 must be repeated for all relevant sample lots.

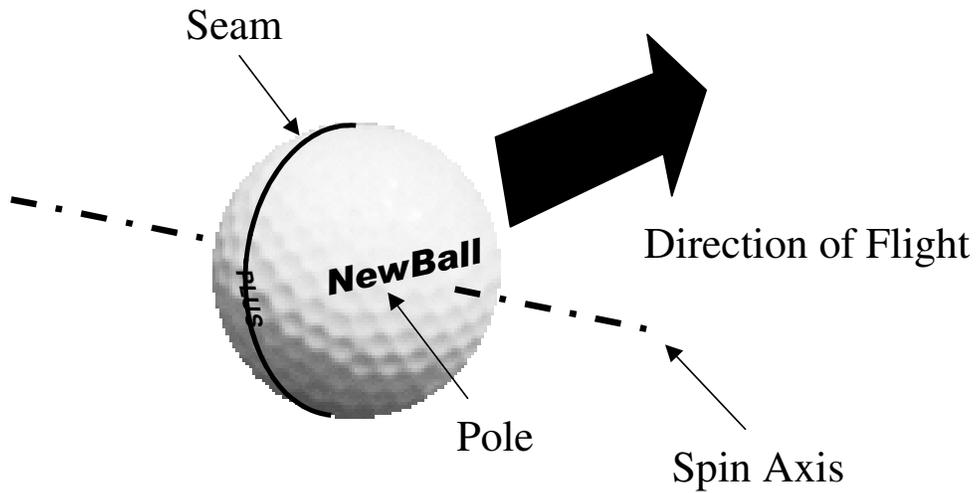


Figure 6.6- Poles Horizontal (PH) Ball Orientation

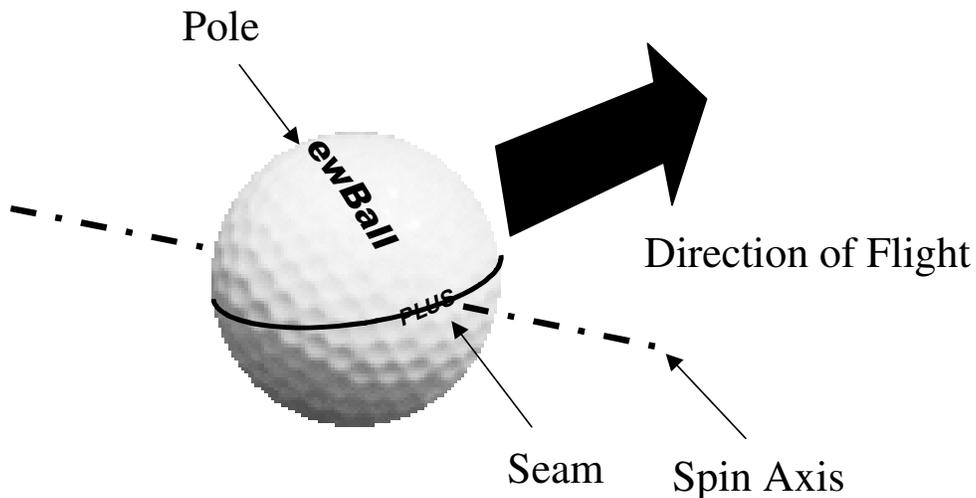


Figure 6.7- Poles over Pole (PP) Ball Orientation

6.10.1 If the repeatability performance is within acceptable limits then proceed to step 7.

7. Conformance Determination

7.1 Using the launch conditions calculated in section 5 and the C_L and C_D calculated in step 6, determine the carry distance, overall distance and flight time at USGA standard environmental conditions (75°F, 30.0 in Hg and 50% relative humidity) for the sample lots in both orientations, PP and PH. (Ref. The ITR Technical Description and Operation Manual, Version 2)

7.2 Overall Distance Evaluation

7.2.1 From the overall distances calculated in 7.1, select the orientation (PP or PH) that produces the greatest overall distance for the sample lot.

7.2.2 If the overall distance determined in 7.2.1 is less than **317.0** yards then the overall distance evaluation is complete and the sample lot conforms to the Overall Distance Standard of the Rules of Golf.

7.2.3 If the overall distance determined in 7.2.1 is greater than **317.0** yards but less than or equal to **320.0** yards then the overall distance evaluation is complete and the sample lot conforms to the Overall Distance Standard of the Rules of Golf. However, a warning letter should be issued to the manufacturer informing them that the overall distance of the sample lot falls within the test tolerance. Any future tests of balls with identical markings from any source could result in a ruling of non-conformance to the Overall Distance Standard.

7.2.4 If the overall distance determined in 7.2.1 is greater than **320.0** yards the ball does not conform to the Rules of Golf.

7.3 Symmetry Evaluation

7.3.1 Using the launch conditions calculated in Section 5 and the C_L and C_D calculated in step 6.9, determine the carry distance, and flight time at standard environmental conditions (75°F, 30.0 in Hg and 50% relative humidity) for the sample lots in both orientations, PP and PH. (Ref. The ITR Technical Description and Operation Manual)

7.3.2 Calculate the differences between the carry distances and times of flight for each ball in the two orientations and compute the mean of these differences

7.3.3 If the mean of the differences in the carry distance calculated in 7.3.2 is greater than **4.0** yards and that value is statistically significant, or if the mean of the differences in the time of flight is more than **0.40** seconds, and that value is statistically significant, then the sample lot does not conform to the Rules of Golf.

7.3.4 The manufacturer shall be notified that the lot has failed the symmetry test and that the lot will be included in the Conforming List of Golf Balls on a conditional basis. The manufacturer shall be requested to take corrective action and re-submit the lot within six-months. If no statistically significant improvement in symmetry performance are made within that period, then the lot will be removed from the next published list.

Appendix A – Test ball and club specifications:

The test head may be purchased directly from the USGA. The calibration ball is available from Bridgestone Sports. The specifications for these are given below.

Test Head Specifications

Construction: Cast 6-4 titanium body, forged SP-700 titanium face

Manufacturer: Fu Sheng Industrial Co., Ltd

Model: TI-360 USGA

Parameter	Units	Nominal Value
Face Depth	inches (mm)	2.0 (51)
Face Width	inches (mm)	3.9 (99)
Mass	ounces (grams)	7.0 (198)
Volume	cubic inches (cc)	22.0 (360)
Hosel Diameter	inches (mm)	0.339 (8.61)
Lie	degrees	58
Loft	degrees	9
Bulge	inches (mm)	12.0 (305)
Roll	inches (mm)	10.0 (254)
CG (face center) up	inches (mm)	0.19 (4.8)
CG (face center) to heel	inches (mm)	0.06 (1.6)
CG (face center) back	inches (mm)	1.38 (35.0)
CG (above ground)	inches (mm)	1.38 (35.0)
CG (from shaft axis-toe)	inches (mm)	1.73 (44.0)
CG (shaft axis-back)	inches (mm)	0.63 (16.0)
Moment of Inertia (pitch)	ounce-in ² (gm-cm ²)	13.1 (2400)
Moment of Inertia (yaw)	ounce-in ² (gm-cm ²)	23.3 (4250)
Moment of Inertia (roll)	ounce-in ² (gm-cm ²)	21.9 (4000)
Characteristic Time		239 μ s

Set-up Ball Specifications

Construction: 2-piece

Manufacturer: Bridgestone

Model: “USGA / R&A Calibration”

Parameter	Nominal Value
Diameter	1.682” (42.72 mm)
Weight	1.59 oz (45.2 grams)
Ball Compression (Atti)	89
Cover material	Surlyn
Cover hardness	60 Shore D
Cover thickness	0.083” (2.1 mm)
Core diameter	1.516” (38.5 mm)
Dimple pattern	Quasi-Icosahedron 432
Initial velocity	253.8 fps (77.4 m/s)
COR (rigid block)	0.778 @143.8 fps (43.8 m/s)