FairPlay Friendship Forever

Quality Control of Hockey Balls for FIH Competitions

January 2012

This schedule has been developed to ensure that the balls supplied for a competition comply with:

- the *Rules of Hockey*;
- the *FIH Performance Requirements and Test Procedures for Hockey Balls* (referred to hereunder as the *Performance Requirements)*.

Sampling

A sample from the total consignment of hockey balls procured for the competition should be selected for testing. 30 balls or 1% of the total consignment (whichever is greater) would normally be appropriate.

Sample balls should be selected from the consignment by an official of the host National Hockey Association or by an FIH Accredited Laboratory appointed for the purpose. The samples shall be selected so they are as representative as possible of the entire consignment of balls. They should be delivered with appropriate security to the laboratory. On receipt of the balls, the laboratory will store them in a suitable environment at a controlled temperature of 23 ± 1C and relative humidity of 55 ± 5% until tested.

Requirements

The Rules of Hockey require a ball:

a is spherical

b has a circumference of between 224 mm and 235 mm

c weighs between 156 grams and 163 grams

d is made of any material and coloured white (or an agreed colour which contrasts with the playing surface)

e is hard with a smooth surface but indentations are permitted.

Further performance requirements are specified in the *Performance Requirements* a copy of which is appended as an annex to this schedule.

Testing protocol

The laboratory will carry out the following test programme on the samples received.

On every ball in the sample:

- determination of sphericity (mean of 3 measurements);
- determination of circumference (mean of 3 measurements);
- determination of mass.

If more than one ball is found not to comply with the requirements in the Rules of Hockey, a further 30 balls should be sampled from the consignment, following the procedure described above (ie each ball is tested for sphericity, circumference and mass). If any ball from this second batch of samples is found not to comply with the Rules of Hockey, consideration should be given to rejecting the entire consignment.

From every 30 balls in the sample, 6. balls should be chosen at random by the laboratory. One is retained as a reference and the remaining five are tested as specified in the *Performance Requirements* covering:

- mass
- dimensions
- surface characteristics
- centre of gravity
- surface friction
- rebound
- hardness
- durability
- water absorption
- shape retention.

All five tested balls must comply fully with the *Performance Requirements*. If any of the balls in the sample of 5 balls fail to meet all the requirements, a further sample of 6 balls shall be taken from the same original batch of 30 balls and five of them tested as specified in the *Performance Requirements*.

If more than one ball from the first set, or any ball from the second set fails, the entire consignment shall be reported as failing to comply with the *Performance Requirements*.

The decision on whether or not a consignment of balls failing to meet the *Performance Requirements* may be used for a competition is the responsibility of the host National Hockey Association or the FIH.

Quality Control of Hockey Balls for FIH Competitions: Annex

FIH Performance Requirements and Test Procedures for Hockey Balls

INTERNATIONAL HOCKEY FEDERATION

PERFORMANCE REQUIREMENTS AND TEST PROCEDURES FOR HOCKEY BALLS

First published: April 1999

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1 INTRODUCTION

The Rules of the Game of Hockey issued under the authority of the FIH Executive Board and its Hockey Rules Board establish requirements for the shape, mass, size, composition and colour of a hockey ball. For certain international matches or tournaments, FIH tournament regulations require the use of FIH approved balls. Through such regulations the FIH will determine either generally or particularly to which international matches the requirements in this document will apply.

The purpose of this document is to notify both manufacturers and users of the performance standards to be achieved before a hockey ball will be approved by the FIH for the specified international matches or competitions and how those performances are to be tested.

2 TEST PROCEDURES - GENERAL

A pre-condition for the issue by the FIH of a product approval for a make of hockey ball is that representative samples of the ball have been tested by an FIH accredited laboratory to the standards and procedures described in these requirements. Upon receipt of a laboratory report showing compliance, the FIH may, subject to any other requirements it may impose, issue a product approval and authorise the use of its logo in advertising and/or on the product itself.

Upon receipt of a request for the conduct of tests to gain FIH approval, a representative of the test laboratory or the FIH will select six specimen balls at random from the manufacturer's or a retailer's stock. One ball should be retained as a reference and the remaining five subjected to the full battery of tests prescribed in these requirements. To be approved all five test balls must comply with the standards; if one fails, a further 6 balls may be selected of which 5 are to be re-tested. If more than one ball from the first set or any ball from the second set fails, the balls are deemed to have failed to pass the test and will not therefore be approved.

Before the commencement of testing, five balls shall be conditioned in a temperature of +50 Celsius and a relative humidity of 0-5 % in an air circulating oven for a period of not less than 24 hours. The remaining sixth shall be retained as a new reference.

The six balls - and in case of re-testing twelve balls - shall be archived by the Test Laboratory and be accessible for a minimum period of ten years or any shorter period in case a re-test overrules the earlier results.

The test programme is to be carried out strictly in the following sequence:

1 Mass

2 Dimensions

3 Surface characteristics

4 Centre of gravity

5 Surface friction

6 Rebound at +5, +23 and +40 Celsius

7 Hardness at +5, +23 and +40 Celsius

8 Durability test
   Mass

9 Water absorption test
   Mass
   Dimensions
   Rebound at + 5, + 23 and + 40 Celsius
   Hardness at + 5, +23 and + 40 Celsius

10 Shape retention test
   Dimensions
   Rebound at + 23 Celsius
   Hardness at + 23 Celsius

Except where indicated all tests shall be carried out under laboratory temperature conditions (in standard atmosphere 23/50 class 1) according to ISO 291 : 1997.

Before any test is carried out, the balls shall be stored under the required conditions for a minimum of 16 hours. Where the test temperature differs from ambient, ie for ball rebound and hardness testing, each ball is removed from the conditioning environment immediately before testing and replaced immediately afterwards.

If an accredited laboratory is requested to re-test a product already approved it shall test in a prescribed manner at least in respect of the characteristics numbered 1, 2, 3, 4, 6, 7, 8, 9 and 10 above. Reports on both initial test, and, where necessary, re-tests shall be completed by the laboratory on the form prescribed by FIH and transmitted to the FIH Office.

3 STANDARDS AND SPECIFIC TEST PROCEDURES

3.1 Mass

3.1.1. Standard — The mass of each ball as received and conditioned shall be not more than 163.0 g and not less than 156.0 g.

3.1.2. Test Procedure — Each specimen ball shall be separately weighed to an accuracy of ± 0.01 g. but may be reported to ± 0.05 g.

3.2 Dimensions

3.2.1. Standard — Each ball shall be spherical and have a circumference not greater than 23.5 cm and not less than 22.4 cm.

3.2.2. Test Procedure — The diameter of each specimen ball be measured to a tolerance of ±0.05 mm using a dial gauge with a 10-25 mm foot along each of 9 diameters. The applied load shall be approximately 200 g and the reading is to be taken 5 seconds after the application of the load. The average of the 9 measured

diameters shall be 73 mm ± 1.75 mm. The maximum allowable differential in range of diameters on any one ball in this test is 0.75 mm.

3.3 Surface Characteristics

3.3.1. Standards — Although small excursions from the nominal surface of the ball are permitted as seams or indentations, no positive excursion from the nominal surface exceeding 0.1 mm over a 10 mm distance nor any negative excursion exceeding 0.5 mm over a 2 mm distance shall be permitted.

3.3.2. Test Procedure — The deviations from the nominal surface in the form of indentations, trade marks, moulding seams and the like shall be measured directly using a probe with a diameter less than 1mm and end radius greater than 10 mm on the dial gauge used for dimensional checks.

3.4 Centre of Gravity

3.4.1. Standard — The centre of gravity of each ball shall be within 0.5 mm of its geometric centre.

3.4.2 Test Procedure — The separation of the centres of gravity and geometry in each ball is determined from multiple weightings, with the ball being rotated between each weighting in a specially designed balance. Details of this procedure are set out in Appendix A.

3.5 Surface Friction

3.5.1. Standard — The coefficient of friction between the ball and a selected wetted sample of an FIH approved unfilled “global” synthetic turf shall be equal to or greater than 0.50 static and 0.35 dynamic.

3.5.2 Test Procedure — Three specimen balls are fixed into an assembly by being taped firmly together leaving the upper and lower surfaces exposed. A board surfaced with the wetted synthetic turf material, and capable of being raised at one end above the horizontal, is prepared. The assembly of three balls is placed on the horizontal board and one end raised until the ball assembly starts to slide. The angle of elevation of the board is measured and the static friction coefficient calculated. The test is then repeated inverting the ball assembly.

The dynamic friction coefficient is calculated in a similar manner, this time measuring the minimum angle of elevation at which the board must be held so that the assembly of balls continues to slide after receiving an initial impulse.

3.6 Ball Rebound

3.6.1. Standard — The rebound height, measured from drop surface to the underside of the ball shall be 575 mm ± 75 mm.

3.6.2. Test Procedure — Each specimen ball shall be allowed to free-fall five times from a height of 2 metres on to a flat horizontal steel plate, having a minimum thickness of 20 mm and resting on a concrete base. For each drop the height of the first bounce from plate surface to the ball underside is measured. In the event that any single result from the 25-drop tests falls outside the permissible range, the re-test procedure must be invoked.

The method of measuring rebound by use of video, acoustic or laser shall have a precision of 10 mm.

3.6.3 Temperature — The test shall be conducted with the balls at temperatures of + 5, + 23 and + 40 Celsius.

3.7 Hardness

3.7.1. Standard — The initial hardness of each specimen ball shall be 175 ± 45.

3.7.2. Test Procedure — The specimen ball is subjected to an impact and the peak deceleration of the impactor is measured. This value, measured in units of G (acceleration due to gravity, 9.8 m's's), is recorded as the hardness of the ball. The apparatus and method of BS 5993: 1994: Annex G shall be used.

3.7.3. Temperature — The test shall be conducted with the ball at temperatures of +5, +23 and +40 Celsius.

3.8 Durability

3.8.1 Standard — The maximum mass loss for any specimen ball after durability testing shall be 0.3 g, compared to the results of test 3.1.

3.8.2 Test Procedure — All five specimen balls are to be placed in a tetrapod drum in which the "step" has been fitted and which has been fully lined with 100 grade silicon carbide paper to BS 871 and tumbled for 3750 revolutions. After tumbling, the balls are to be washed in water dried at +50 Celsius for 16 hours and then weighted as per section 3.1.2.

3.9 Water Absorption

3.9.1 Standard — After the completion of the water absorption conditioning, the following maximum changes in performance shall apply:

- mass: maximum increase of 0.3 g (the established weights of the specimen balls following the durability test are taken as the baseline weight for the purpose of this test);
- dimensions: to remain within the requirements of 3.2;
- ball rebound: maximum mean change of 120 mm;
- hardness: maximum mean change of 12 %.

3.9.2 Test Procedure The specimen balls are submerged in water at +50 Celsius for 24 hours. Upon removal they are dried with a towel and the tests 3.1, 3.2, 3.3, 3.6 and 3.7 are then carried out after the ball has come to room temperature.

3.10 Shape Retention

3.10.1 Standard After completion of the shape retention test, the following maximum changes in performance shall apply:

- dimensions: diameters to remain within the requirements of 3.2 with a maximum range of 1.75 mm;
- ball rebound: maximum mean change of 60 mm;
- hardness: maximum mean variation of 25%.

3.10.2 Test Procedure The ball is subjected to 200 repetitive impacts using the apparatus of 3.7 over a period of between 20 and 30 minutes, the ball being free to rotate between impacts. The ball is allowed to recover for 5 minutes and tests for Dimensions (3.2.2) and Rebound (3.6.2) are then carried out within the next five minutes.

The balls are then left to cool for a minimum of 3 hours and then the hardness test (3.7) is carried out but at a temperature of +23 Celsius only.

APPENDIX A

PERFORMANCE REQUIREMENTS FOR HOCKEY BALLS

Centre of Gravity Balance and Method

In order to measure the distance between the geometrical centre of a hockey ball and its centre of gravity, a balance has been constructed, based on a two-pan laboratory balance of 200 g capacity.

Normally in this type of balance both specimen and weights are suspended on knife-edges from a beam which is itself supported on knife-edges. The relative positions of the knife-edges determine the sensitivity of the balance and, together with the moment of inertia of the beam, determine the response time of the balance. Knife-edges are used to ensure that the centres of mass of the specimen, and the weights always act directly on the same point on the beam.

In determining the position of the centre of gravity of a ball it is necessary to maintain its geometrical centre at the same position on the beam, so the specimen pan and its knife-edge support are replaced by a ball holder rigidly mounted on the beam. This ball holder is made as light as possible consistent with rigidity, and holds the ball so that the height of the centre of gravity of the holder with a ball in place is close to the height of the original knife-edge. In practise the combined centre of gravity will normally be below the original knife-edge, which results in a slight loss of sensitivity, but the available sensitivity is more than sufficient. The ball holder must also allow the ball to be placed in the three mutually perpendicular orientations without any misplacement being caused by seams or other surface protrusions, and must support the ball on areas sufficiently large to avoid any misplacement due to the presence of dimples or other depressions. It is not necessary for the ball holder and the empty weight pan to balance.

To find the position of a ball's centre of gravity, three mutually perpendicular axes are defined and marked on the ball. The ball is placed in its holder with an axis parallel with the balance beam and weighed. The ball is then turned, so that the same axis is parallel with the balance beam but in the opposite orientation, and re-weighed. This process is repeated for the other two axes, making six weighings in all. The six weights may be denoted X , X , Y , Y , Z and Z . If the ball's centre of gravity is not coincident with its geometrical centre there will be a difference in at least one of the pairs of weights. In practice there will usually be a difference in all three pairs of weights.

Denoting the balance arm length 'L' (ie the horizontal distance between the central knife-edge and the weight pan knife-edge), the mass of the ball 'M' and the difference between the two weights on the X axis ' Mx', the centre of gravity error on the X axis is given by (Mx x 1/2L/M). The errors on the other axes may be similarly calculated. Using x, y and z to denote the errors on the three axes, the distance 'E' between the geometrical centre and the centre of gravity is given by :

$$E = (x + y + z\ )$$