

Introduction

This leaflet describes, for the benefit of manufacturers and as a support to players the tests, which are applied to table tennis balls by the ITTF, and gives details of the criteria used in granting or withholding approval (chapters A - D). All ball brands approved have to meet all appearance standards and all qualitative and quantitative criteria described in the following sections. The procedure for ITTF approval is described in Technical Leaflet T7. Extended information about testing procedures are established by the Equipment Committee as an appendix to the present Technical Leaflet and are available to associations and manufacturers from the ITTF web-site.

Terms of reference

The Laws of Table Tennis relating to the ball are as follows:

- 2.03 The Ball
- 2.03.01 The ball shall be spherical with a diameter of 40mm
- 2.03.02 The ball shall weigh 2.7g
- 2.03.03 The ball shall be made of celluloid or similar plastics material and shall be white or orange, and matt

Regulations for International Competitions require equipment authorized or approved by the ITTF.

Approval of Ball Brands

A supplier may have approved ball brands differing in:

- colour, i.e. white and orange
- material, i.e. celluloid and non-celluloid
- brand name and trademark

Material

Notwithstanding the instability and flammability of celluloid, it has always been the standard material for a table tennis ball. The Laws do not prescribe the material, leaving manufacturers free to experiment. We need better materials, and manufacturers are still encouraged to search for these and optimize them.

The ITTF Equipment Committee will approve balls with a playing performance similar or identical to that of celluloid balls. Therefore, the specifications for non-celluloid balls are as identical as possible to the ones for celluloid, with slight adjustments that proved reasonable to support the task of inventing a new material. Our goal is that balls of any material shall have the same good level of quality and stable properties, which must not change at typical use before, during and after play, except a regular ageing, which should be kept at a minimum. E.g.: Permanent indentations or stress whitening as well as a flimsy or battered appearance must be clearly avoided.

A. Qualitative Criteria and Appearance

A.1 General Appearance

The ball shall be white or orange, and matt (see B. 12). Balls differing in colour may have the same trademark, but shall be otherwise identical in appearance.

A.2 Seam

A ball must appear to be uniform. In particular there must appear to be only one seam. After the two halves of the ball have been jointed in manufacturing, the ball may be subsequently moulded. If the equator of the ball - i.e. the joint - is not coplanar with the line of separation of the two halves of the mould, another line will be formed, looking like a second seam. This is not acceptable.

When there is no seam, artificial seams will be applied by the laboratory for testing purposes, refer "Appendix - Marking balls without seam" at the end of this document.

A.3 Stamp

The stamp on a ball may cover an area no greater than 280mm². It may be printed in one or two colours, but the same colour or combination must be used for all balls of the same brand and colour. The wording used in the stamp has to be in compliance with ITTF regulations (see chapter "C. Marking").

For designated events, the ITTF may allow a second stamp to be applied on balls which are already ITTF approved and will be used only in that event. In this case, the second stamp shall be on the opposite site of the sphere and the lettering of both stamps shall have the same orientation. This means, if the center of the first stamp is interpreted as a point on the equator, the center of the second stamp shall be 180 degrees of longitude away and both letterings shall have their top side towards the north pole. The permission to print a second stamp and the design of the second stamp shall be individually authorized by the ITTF.

A.4 Packaging

The balls must be packaged appropriately, e.g. in paper or plastic boxes or in a blister pack. The wording used on this package shall contain either

"40" or "40mm" for celluloid balls, or
"40+" for non-celluloid balls.

Any packing of the balls, even those for big quantities, must contain a date code and must be in compliance with the ITTF regulations (see chapter "C. Marking"). If a big packing contains several small packings, this requirement applies to both.

B. Quantitative Criteria

Tests are conducted on groups of 24 balls; the number normally purchased is one package more than is needed to provide this number (i.e. usually 30 balls). Statistical "outliers", i.e. values which are so unlikely that an error cannot be excluded, are ignored when calculating means and standard deviations, but all values within a normal distribution but outside the permitted limits are included. All calculations of a standard deviation are assuming a sample and not a population, i.e. they use a denominator of "n-1".

Note: „Conformity" means compliance with a specification set down in the Laws of Table Tennis or Regulations for International Competitions, and „regularity" means degree of uniformity within a sample.

Anyone wishing to know how we analyze test results statistically is invited to contact the ITTF Equipment Manager.

Test Procedures

The ITTF equilibrates balls at 23° ($\pm 1^\circ$) Celsius, 50% ($\pm 5\%$) R.H. for at least three days (standard conditions according to Class 1 EN ISO 291). For seamless balls the colour test should be done first and then the ball should be equipped with artificial seams according to the Appendix.

Weight is measured on an electronic analytical balance reading to 0.001g, and the results are rounded to the nearest 0.01g.

Diameter We use a calibrated electronic device with a precision of at least 0.001mm which measures the diameter with a precision of 0.01mm. The ball is fixed by a vertical pin (diameter 10mm). The force of the pin is kept as small as possible, but strong enough to guarantee that the ball is absolutely fixed. A force up to 5 (five) N has proved not to influence the diameter of the ball. For fixation the ball is supported by an annular ring whose upper inside surface slopes at an angle of 45 degrees. The outer diameter of the ring is 40mm and the inner diameter at the bottom of this slope is 20mm. In this position the ball is placed between two lateral, horizontal flat measuring pins (diameter 6mm), which automatically adapt to the ball diameter by soft springs. The force of the soft springs is between 0.5 and 1.5 N.

For balls with seam:

The diameter of the ball is monitored while turning the ball with a mechanical device about the polar axis (1), an axis crossing the equator twice perpendicularly and comprising the center (2), and about further two arbitrary axes comprising the center of the ball (3 & 4). By (1) the seam line, by (2) a line including both poles and by (3) and (4) arbitrary lines on the balls surface are monitored.

For balls without seam:

The diameter of the ball is monitored while turning the ball with a mechanical device about the red line (1), the blue line (2), the green line (3) and about one further arbitrary axis (4). By (1) the seam line, by (2) and (3) two lines including both poles and by (4) one arbitrary line on the balls surface are monitored.

For all balls:

By rotating the ball about the described axes the minimum and maximum diameters are determined. The difference between the two values gives the lack of sphericity.

Alternatively, the following procedure can be applied: The ball is placed arbitrarily between a flat and the measuring pin, and the diameter is measured. In order to guarantee that the measuring pin is vertically above the center of the ball we use two vertical flats with angle of 90° against which the ball is horizontally pressed during the measurement. By rotating the ball in various directions the minimum and maximum diameters can then be determined. The difference between the two gives the lack of sphericity.

Bounce is measured by releasing the ball mechanically without spin. After its bounce on a standard steel plate the ball is monitored with a digital camera with a calibrated mm scale in the background. The photos are evaluated. The geometric mean of three determinations then permits calculation of the maximum height of bounce of the "south pole" of the ball. A standard steel plate is made of Steel S235 with a surface roughness of $R_a \leq 1.0 \mu\text{m}$ and $R_{\text{max}} \leq 7.5 \mu\text{m}$. The size is no smaller than 20mm thick and 200 x 200 mm large.

Alternatively the rebound height can be measured by other methods, which give the same results.

Results from any optical method used must take into account a possible parallax error.

Veer is a measure of the total sphericity of the ball, not merely its external aspect. It is measured by rolling the ball down a slight incline onto a horizontal surface, and measuring the distance by which it deviates from a straight line, the "centre line", as it rolls across the surface. The incline is 100mm long at 14 degree to the horizontal; on a table that is 100cm long this gives a rolling time of about 3 seconds. Each ball is measured three times. A negative result is reported if the ball fails the test twice. A "failure" is defined as the event that the ball is hitting one of the two "side lines" which run parallel to the centre line in a distance of 175mm to the left and 175mm to the right.

We will register where a ball eventually hits the side line measured from the start point; $X1 = 0 - 50$ cm, $X2 = 50 - 75$ cm, $X3 = 75 - 100$ cm and $o =$ ball does not hit the side line at all. This is for collecting data for the future.

The rolling surface is at least 20mm thick with a roughness of $Ra \leq 1.0 \mu\text{m}$ and $Rz \leq 7.5\mu\text{m}$.

For balls with seam: Rolling twice on the seam, and once about an arbitrary axis.

For balls without seam: Rolling one time on red, blue and green lines.

Hardness is measured on a fully automated and computerised Zwick tester (or equivalent). We use a preload of 0.5 N and testing starts 10 sec after preloading. A 20mm diameter pin presses against the ball with a 50 N force loaded at 10 mm/min, and the indentation is recorded with a precision of 0.01mm. The ball is supported by an annular ring whose upper inside surface slopes at an angle of 45 degrees. The outer diameter of the ring is 40mm and the inner diameter at the bottom of this slope is 20mm.

Measurements are made on each pole and once on the seam / red line (see Appendix E); the average for the poles provides a measure of the hardness, and the difference between that and the seam indentation is a measure of the lack of symmetry for hardness.

Colour: The ball colour is measured and calculated according to the CIE Lab system, giving three values ΔL , Δa and Δb ($\Delta =$ Greek letter "delta" meaning "difference"). These values show the differences compared to the Munsell color standards given below for white and orange. L indicates the black/white value on a scale from 0 to 100; "a" indicates the green/red value; and "b" the blue/yellow value, both on a scale from minus to plus 100. The measurements are performed on 3 points, one on the seam and two on other points positions on the surface, of 4 balls randomly chosen from different boxes. ~~If no seam is available three random points of measurement have to be taken. 4 balls are selected from different boxes. The L, "a" and "b" values of the sample are determined by averaging over all 4 balls.~~ The device is a Spectrophotometer according to ISO 7724 (D65/10° incl. gloss) with a black velvet hemisphere behind the ball as background for the measurement. Supplier of Munsell Standards: X-Rite Inc., 4300 44th Street S.E., Grand Rapids, MI 49512 U.S.A.

Specifications

For the calculation of the following values two digits are taken into account.

B.1 Weight Conformity

Law 2.3.2 specifies 2.7g, but any weight between 2.67 and 2.77g is acceptable for any one ball. No more than 1 ball out of the 24 sampled may be outside this range. The sample mean must be between 2.69 and 2.76g. In carrying out statistical calculations we treat any weights less than 2.60g or greater than 2.85g as outliers.

B.2 Weight Regularity

The standard deviation may not exceed 0.03g.

B.3 Size Conformity

For celluloid balls:

The minimum diameter of every ball must be at least 39.50 mm, and its maximum diameter must not exceed 40.50 mm. The sample mean average diameter, i.e. the mean of the average of the maximum and minimum diameters for each ball, must be in the range 39.60-40.40 mm. Values below 39.25 mm or above 40.75 mm are considered in our calculations as outliers.

For non – celluloid balls:

The minimum diameter of every ball must be at least 40.00mm and its maximum diameter must not exceed 40.60mm. The sample mean average diameter, i.e. the mean of the average of the maximum and minimum diameters for each ball, must be in the range 40.00-40.50mm. Values below 39.70mm

or above 40.75mm are considered in our calculations as outliers.

B.4 Size Regularity

The standard deviation of the average diameter may not exceed 0.06mm.

B.5 Sphericity Conformity

For celluloid balls:

The sphericity of any ball must be less than 0.35mm, and the sample mean sphericity must be less than 0.25mm. (The sphericity of a ball - more correctly the lack of sphericity - is the absolute difference between its minimum and maximum diameters.) In our calculations values greater than 0.50mm are treated as outliers.

For non – celluloid balls:

The sphericity of any ball must be less than 0.25mm, and the sample mean sphericity must be less than 0.20mm. (The sphericity of a ball - more correctly the lack of sphericity - is the absolute difference between its minimum and maximum diameters.) In our calculations values greater than 0.30mm are treated as outliers.

B.6 Sphericity Regularity

The standard deviation of sphericity must be less than 0.06mm.

B.7 Bounce Conformity

All 24 balls must rebound to a height of not less than 240mm and not more than 260mm when dropped from a height of 305mm on to a standard steel block.

For non-celluloid balls all 24 balls must rebound to a height of not less than 240mm and not more than 265mm when dropped from a height of 305mm to a standard steel block.

B.8 Bounce Regularity *(to be examined)*

There is no specification for this property. Dynamic tests will be investigated.

B.9 Veer

No more than two balls shall fail, i.e. deviate twice by more than 175mm from the center-line.

B.10 Hardness Conformity

For balls with seam:

The geometric mean pole hardness for any ball shall be in the range **0.68 – 0.81mm**.

The geometric mean pole hardness for the sample shall be in the range **0.69 – 0.81mm**

The mean seam hardness for the sample shall be in the range **0.72 – 0.83mm**

The within-ball (uniformity) coefficient of variation of the measurements on each pole and once on the seam shall be no greater than **0.17mm**.

The sample mean within-ball (uniformity) coefficient of variation shall be no greater than 0.08mm.

For balls without seam:

The geometric mean hardness for any ball shall be in the range 0.70 – 0.90mm.

B.11 Hardness Regularity

The coefficient of variation shall be not greater than 0.06mm.

B.12 Colour

The specifications for the L, a and b values according to the CIE Lab system are

for white balls: **Standard reference: Munsell notation: N9.5/ M**

$$-6 \leq \Delta a \leq +5$$

$$-12 \leq \Delta b \leq +5$$

$$-21 \leq \Delta L$$

for orange balls: **Standard reference: Munsell notation: 7,5YR 8/10M**

$$-15 \leq \Delta a \leq +10$$

$$-15 \leq \Delta b$$

$$-10 \leq \Delta L$$

~~All 4 balls tested have~~ The average of the 12 measured points (4 balls, 3 points each) has to meet these standards. Any decimals in the measurement are rounded as usual, for example $\Delta b = -12.4$ is acceptable for white balls, whereas -12.5 is not.

B.13 Material thickness

For non – celluloid balls:

Material thickness shall be measured using an ultrasonic device on the 6 measuring positions. This is done on the 5 samples which were worst in the veer test, and the 5 samples which were best. This is only for collection of information in order to further improve balls and methods.

B.14 Durability and friction

Tests for the durability of the ball and its friction against table surfaces and/or a standardized surface are currently being developed. Manufacturers shall be prepared that these tests will be included in the approval process in the future, after being described in detail in this Technical Leaflet.

C. Marking

If the grade of the ball is indicated by a numbering system, no number higher than 3 may be used, e.g. „Three Star“.

C.1 The Stamp

The stamp on the ball must include the following four components:

- The ITTF Approval. This may be indicated by the initials "ITTF" or by "ITTF approved", or by the ITTF logo.
- the trademark or brand name
- the inscription "Made in", followed by the country of production
- the inscription of either:
 - “40”, or “40mm” for celluloid balls
 - “40+” for non-celluloid balls

The stamp on the ball may not include any other components.

If the production process is taking place in more than one country, the reference shall be to the main step of production. For example,

- if the ball is made of two halves which are produced in country A and put together in country B, the reference is country A

- if the raw material of the ball is originating from country A and any material processing is done in country B, then the reference is country B

Any case of doubt shall be brought before the ITTF Equipment Manager and will be decided by the ITTF case by case.

The same text must appear on all balls of an approved brand. I.e. it is not permitted to put one country name on some balls and a different one on others with the same brand name. Wrong claims will be penalized with a fine and can lead to immediate withdrawal of the ITTF approval.

No other text is permitted. The stamp may cover an area no greater than 280mm² described by a circle or a rectangle with a maximum side length of 25mm circumscribing all letters and symbols. It may be printed in one or two colours, but the same colour or combination must be used for all balls of one brand. All inscriptions must be easily readable. The trademark or brand name should be the most pronounced inscription.

The requirements of Section C.1 do not apply to the secondary stamp for specific events (see A.3).

C.2 Trademark or Brand Name

The Approval of the ITTF, the country or the expression "made in" are not considered to be part of the trademark or the brand name. The trademark or brand name must be unique and may not be used for another type of ball, especially not for an unapproved one. All balls with the same trademark or the same brand name must have the same level of quality.

Also, a celluloid and a non-celluloid ball of the same supplier must not carry the same trademark or brand name, respectively. If the supplier wishes to brand his celluloid and non-celluloid balls as similar as possible, the minimum difference accepted is that the term "40+" is added to the brand of a celluloid ball to define the brand of a non-celluloid ball. For example, "Super Supplier – Mega Brand" and "Super Supplier – Mega Brand 40+" are an acceptable combination for the brand name.

With a brand name containing "40+", both requirements no. 2 and 3 of C.1 are considered as fulfilled. However, the "40+" then cannot just be used on the ball stamp, but must be used everywhere (packaging, sales channels, advertisements etc).

An ITTF approved ball may lose its approval if the supplier markets another non-ITTF-approved ball with the same or similar appearance as the ITTF approved one, with which it could be confused.

The ITTF will make its best effort to ensure that the trademark or brand name does not infringe on the already existing balls brands. The ITTF is not responsible for any illegal use of registered trademarks. Verifying the correct and legal use of trademarks is not part of the ITTF approval procedure.

C.3 Packaging

The packaging must have the same information as is on the stamp, however the ITTF logo is obligatory and shall be used as described in section C.5. In addition, the packaging may also include the name of the country where the company headquarters are registered and may have additional information such as technical data or national approvals. The wording used on the packing may not contain false claims.

C.4 Date Code

All packagings (see A.4), but not the ball itself, must be marked with a date code corresponding to the date of production (month / year). The date code must be readable without the need to destroy the packing.

The date code consists of 4 characters: the first 2 for the month and the last 2 for the year. Month and year are encoded using the capital letters from A to I for the numbers 1 to 9 (A = 1; B = 2; etc. up to I = 9; X = 0).

Examples: a) ABXC means 1203, which is decoded as December 2003.









b) XEAA means 0511, which is decoded as May 2011

This date code system is mandatory for all ITTF approved ball brands.

Manufacturers are strongly encouraged to clarify the design of the stamp, the packaging and the date code before production with the ITTF Equipment Committee.

A missing date code is penalized with a fine.

C.5 Guidelines for the use of the ITTF Logo on the ball and the packaging

THE STAMP	
<p>Recommended: LOGO 4 (Line Art Version: Black On White Background)</p> 	<p>The stamp on the ball must include the ITTF Approval as described above. This may be indicated by "ITTF", "ITTF approved", or by the ITTF logo.</p> <div style="display: flex; justify-content: space-around; align-items: center;">    </div> <p>When the ITTF logo is printed, it should:</p> <ul style="list-style-type: none"> • be in Black or Gray, but not in any other colours • not have text or shapes overlapping it, although the safety area is not mandatory for printing on balls <p style="text-align: center;"> ✘ Incorrect ✔ Correct </p> <div style="display: flex; justify-content: space-around; align-items: center;">    </div>
THE PACKAGING	
<p>Recommended: LOGO 1 (3D Logo: Green On White Background)</p> 	<p>The ITTF Logo can also be printed on the packaging, but should adhere to the guidelines stated in the "ITTF Branding Guidelines v3.0".</p>

For more information, please refer to the ITTF Branding Guidelines v3.0: <http://bit.ly/2ybHNbw>
 All versions needed, of the ITTF logo, can be found here: <http://tiny.cc/ittflogos>

D. Administrative Matters

D.1 Changes

Any change of the trademark or the brand name, the date code, the stamp, the packaging, the ball quality, the source of supply and any other changes relevant for ITTF approval must be notified to the ITTF Equipment Committee. If the stamp or box design is changed two boxes must be sent to the address given on the ITTF.com under "Equipment / Balls". The changes must be confirmed by the ITTF **in writing**.

The failure to announce changes to the ITTF will be penalized with a fine or can even lead to an end of the ITTF approval in cases of severe or repeated failures.

D.2 Publication

A list of all ITTF approved ball brands is published in the Internet. The approval list is published in alphabetical order by trademark or brand name.

D.3 Approval Code

The ITTF uses an approval code consisting of

- a serial number according to the date of application for ITTF approval and
- the month and year of application for approval.

Example: ITTF-21-B-06/00; meaning: 21st ITTF approved ball (B), approved in June 2000. The manufacturer is free to use the approval code in his advertisements.

E. Appendix – Marking balls without seam.

General:

Balls without seam must be equipped with artificial seams for testing. This is to obtain an even distribution of the measurements. There would be no end in measuring if we should check every theoretical spot on the ball. Instead, we are trying to get some distributed data through a simpler procedure.

The sequence of testing is not important, apart from colour testing which should be made before the marking of lines / "seams".

Sequence:

1. Individual numbering of the received balls - beginning with no. 1 - in an arbitrary position.
2. Measuring colour, on 3 independent spots.
3. Drawing an "equator" under the number with **red** ink.
4. Making a **blue** circumference 90° perpendicular on equator on the right side of the number.
5. Making a **green** circumference 90° perpendicular both on equator and on the **blue** line on the left side of the number.
6. We will now have 6 measuring positions; i.e. 4 along the **red** equator where **blue** and **green** lines cross, and 1 on each pole ("**North**" is above the number and the equator and "**South**" is below); in addition to the 3 circumferences, i.e. the **red**, **blue** and **green** lines.
7. The balls are then ready for testing.
8. These designations to be used in the reporting.

End of T3