ITTF.com

The International Table Tennis Federation (ITTF) intends to measure 2 essential properties of the ball bounce on the table, as described below.

Call for a tender about the

DEVELOPMENT, CONSTRUCTION, DELIVERY AND WARRANTY OF A DEVICE ABLE TO DETERMINE BOUNCE PARAMETERS OF A TABLE TENNIS BALL ON A TABLE SURFACE

On various spots of the table surface, ITTF wishes to determine the "bounce height" and the "friction" between ball and table top.

Once the "start" button is pressed, a (rotating or not) ball is dropped onto the surface, followed one by one until the maximum chosen. For one spot, the maximum number of balls fed to the head shall be 10; they shall be contained in a tube of a length of 40 cm and descend by gravitation. The recording of the values in the device of the successive measurements must be completely automatic for that spot. The transfer of the measures to a computer for operating the calculation may be synchronic; a semi-automatic way may be better so that the measurement on the table can be done without the device being linked to a computer.
All calculations and output apps have to be included in the tender, and details of the software must be provided.

The frequency of the unit spinning the ball must be automatically controlled and adapted to the pre-determined value; a digital dial shall show the frequency of rotation of the ball before dropped.

Please also indicate how much it may cost more if instead of only one pre-determined frequency, we add up to 3 more frequencies, which may be used for other purposes than for measurements on the table.

High speed cameras should not be used.

Balls and table top samples necessary for the verification and calibration of the device will be delivered by ITTF.

As the device will be used in humid regions, it must be protected against corrosion. Please detail how.

More details are given below; they may permit other considerations; it's the tenderer's decision how to deal with the information that we give.

Detailed instructions for assembly and use must be provided. A warranty on precision of 48 months, including costs for work, transport and pieces must be given.

Please, make a quote for the construction and delivery of 1, 3 or 5 devices. The quote shall arrive before July 25, 2018 at equipment@ittf.com.

Indicate the deadline in months required for the delivery of the device(s) after order is confirmed.

The ITTF reserves its right to decide about the final achievement of the project.

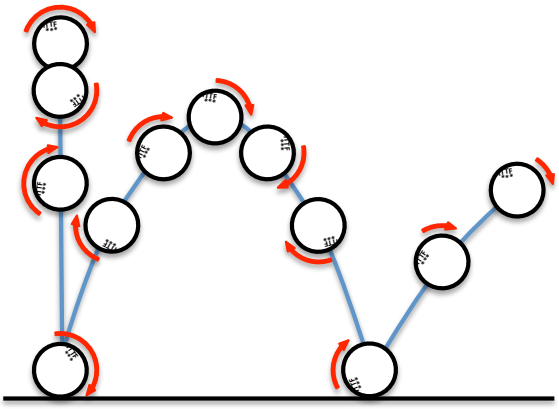
Equipment Committee

Functional Requirements for Device to determine rebound properties of table tennis balls on table surfaces

Overview

The device shall determine both the two impact parameters CoF (Coefficient of Friction) and CoR (Coefficient of Restitution) by analysing bounce parameters. The experimental conditions described below are adapted to the intensity of real table tennis impacts and must be respected.

The device shall drop a table tennis ball with a well-defined spin from a well-defined height on a table surface.



CoF and CoR may be determined from velocity components instantly before and after impact. Therefore, the device has to include suitable measurement methods.

Another indirect method is described below; it has to include suitable measurement methods.

Requirements for dropping the ball

1) **Head to drop the ball**: Mechanism to clutch, to spin up and to release table tennis balls.

- Double-sided central clutch of the ball between two plates.
- Both plates should be rotatable around the same axis.
- One of the plates should be driven by a spinning motor, the other one equipped with a bearing.
- To attach and release the ball the plates can be moved in direction of the spinning axis.
- Motor should be able to spin up to 120 rev/s
- A dropping spin of 67 rev/s must be a pre-fixed value.
- The accuracy of the spin shall be +/- 1 rev/s

2) **Stative**

- Drop height of 18.0 cm +/- 0.1 cm (other pre-determined heights may be possible 16.0, 17.0, 20.0, 25.0 cm)
- The drop-head should be fixed on a stand
- As the device should be suitable for measures on table top tiles as well as on complete tables, it has to be portable and should not weigh more than 10 kg.

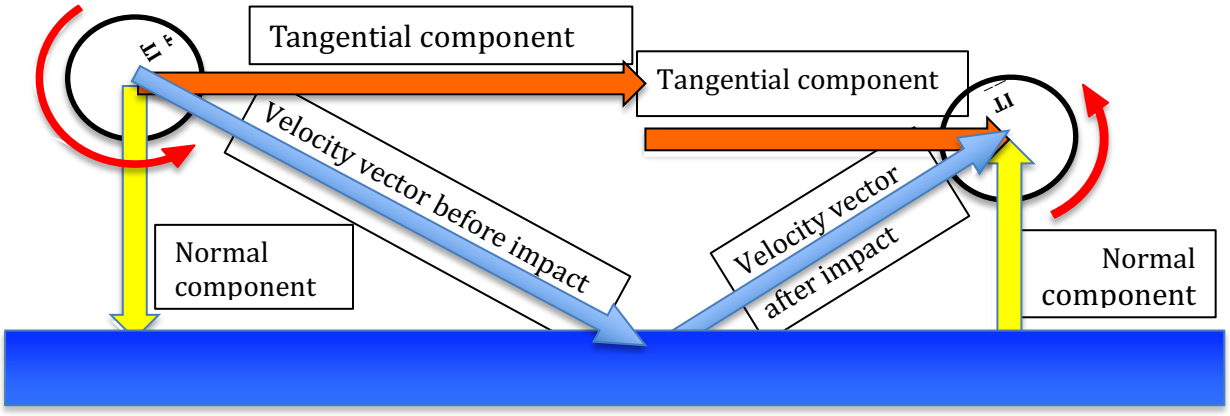
Measurement possibilities and requirements:

To determine CoF and CoR there are different methods possible to be used. The measurement methods should be automated. The measures may be visible on the device, if the tenderer considers this an advantage (The tender may detail design and costs of such additional indicator).
The calculation and generation of results may be immediate. Alternatively, it is also possible to use methods where measuring is a recording process and data exploitation is done later automatically or manually. But then the time needed for data exploitation of one experiment and a series of experiments has to be evaluated and indicated.

Possibility 1: Velocity measurements

One method is to identify velocity vectors of the ball before and after the impact.

- Due to the slow velocities involved, care must be taken to really determine the instant velocity right before and after impact. Thus, it may be required to incorporate a gravitational correction.
- For those small velocities aerodynamic effects may be negligible.



CoR and CoF are calculated according to the following equations:

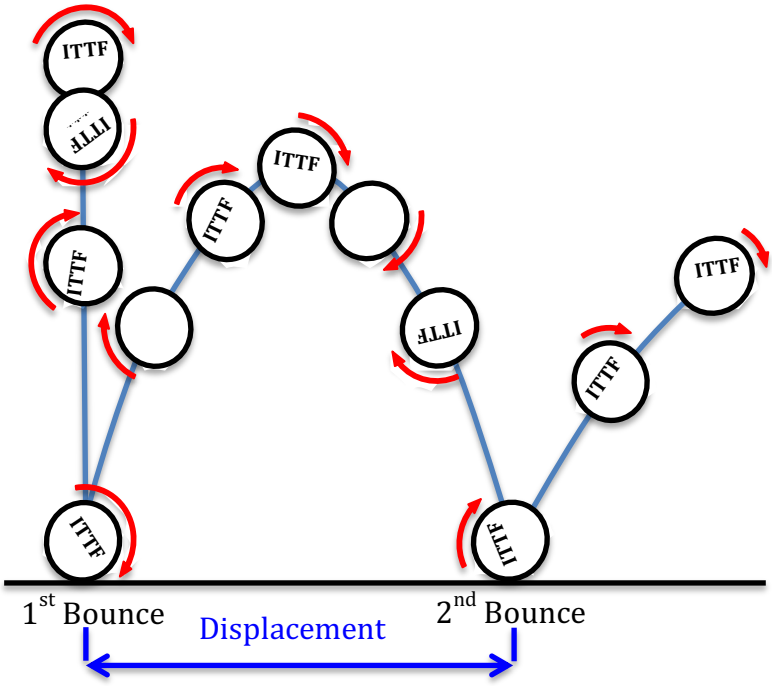
$$CoR = -\frac{v_{n1}}{v_{n0}} \qquad CoF = \left|\frac{v_{t1}-v_{t0}}{v_{n1}-v_{n0}}\right|$$

v_{n0} is the normal velocity before impact and v_{n1} after the impact. Accordingly, v_{t0} is the tangential velocity component before and v_{t1} after the impact. It is important to mind that velocities have a negative or positive sign dependent on the direction.

Possibility 2: Measurement of distance and time

It is also possible to work with following indirect measurands:

- The lateral displacement Δx between first and second bounce and "rebound height".
- The latter then again may be determined from the timespan Δt between first and second bounce.



An elementary calculation leads to the following equations to calculate CoR and CoF.

$$CoR = \Delta t \sqrt{\frac{g}{8h}} \qquad CoF = \left| \frac{\Delta x}{\Delta t \left(\frac{1}{2} g \Delta t + \sqrt{2gh} \right)} \right|$$

Measurement accuracy

for a sufficiently precise determination of CoF and CoR

CoF and CoR have to be determined with an accuracy of +/- 0.01. Using physical modelling it is possible to conclude on the requirements for the accuracy of the measurands:

- If velocities are used then the velocity components have to be determined with an accuracy of +/- 0.01 m/s.
- If the time delay Δt and displacement Δx between first and second bounce are used, then the requirement for the time measurements is +/- 2 ms and for the localisation of the touch points of +/- 1 mm.