

## Introduction

For many decades we have played table tennis on wooden floors, whose properties have been much appreciated by our players. Nowadays they are quite expensive, are becoming more difficult to find and are replaced by more point-elastic flooring systems. Furthermore, the wooden floors that we have used, even in major events such as the World Championships, have often been, to our eyes, disfigured by markings of other sports; in recent years we have seen more and more floors covered by other materials, either to upgrade a floor made of an unsuitable material without sporting qualities such as concrete, or to cover those markings, or to enhance the presentation through a more adequate colour, or to allow similar playing conditions all around the world, or to allow to apply advertising belonging to the ITTF or the organizer. That covering can be of painted wood, but more often it has been a synthetic laminate.

The International Table Tennis Federation tests and approves flooring, thus setting a high standard for sporting quality and safety during international competitions. Information and instructions for applying for or renewing ITTF approval of floors and information about the approval 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.

The objects of this leaflet are to describe the optimum for non-permanent flooring; to illustrate the need for compromise between medical, financial, sports and other criteria as presentation inside a venue or at TV; and to assist manufacturers, architects and engineers on the design of flooring material.

The supplier and the user always shall keep in mind that table tennis players need to move with short steps which include many starts and stops as well as rotations, and that the soles of the footwear used may vary from softer rubber to harder polyurethane. The floor shall neither be slippery through its surface or too a high restitution of energy so that safe starts and stops are possible nor be sticky so that the feet cannot follow the numerous rotations of the body which may harm joints and ligaments; it shall not be too hard bearing the risk of shocking the joints as especially knee and hip or be too soft so to excessively stress and tire the muscles and increase players' impression that the game is slowed down. Finally the colour and gloss are important factors for the attractive presentation in the venue and at TV, keeping also in mind that the table tennis ball is small and most speedy.

The present leaflet only applies to non-permanent table tennis mats or flooring systems. The ITTF intends to develop similar requirements for permanent sport floors and to entrust Testing Institutes all over the world to check the good suitability of permanent floors for table tennis practice and events; ITTF may issue a payable label "suitable for table tennis".

## Terms of reference

The Regulations for International Competitions of the ITTF relating to flooring are:

- 3.2.1.1 The approval and authorisation of playing equipment shall be conducted on behalf of the Board of Directors by the Equipment Committee; an approval or authorisation may be suspended by the Executive Committee at any time and subsequently the approval or authorisation may be withdrawn by the Board of Directors.
- 3.2.3.2 The following equipment and fittings are to be considered as part of each playing area: ..., flooring, ...
- 3.2.3.8 The flooring shall not be light-coloured, brightly reflecting or slippery and it shall be resilient; the flooring may be rigid for wheelchair events. In World, Olympic and Paralympic title competitions the flooring shall be of wood or of a brand and type of rollable synthetic material authorised by the ITTF.
- ~~3.2.5.5 There may be up to 4 advertisements on the floor of the playing area, 1 at each end, each contained within an area of 5m<sup>2</sup>, and 1 at each side of the table, each contained within an area of 2.5m<sup>2</sup>; they shall not be less than 1m from the surrounds and those at the ends shall not be more than 2m from the surrounds.~~
- 3.2.5.5 There may be up to 6 advertisements on the floor of the playing area; such markings
- 3.2.5.5.1. may be placed 2 at each end, each contained within an area of 5m<sup>2</sup>, and 1 at each side of the table, each contained within an area of 2.5m<sup>2</sup>;
- 3.2.5.5.2. at the end shall not be less than 3m from the table's end line next to the marking;

Another technical document whose reflections, methods and conclusions are inspiring the present technical leaflet is the European Norm EN 14904 "Surfaces for sports areas – Indoor surfaces for multi-sports use – Specification" and similar continental or national norms.

## Criteria and objectives of specifications about flooring in table tennis

A goal of the ITTF is to give players safe, not straining and nearly the same playing conditions everywhere.

A second one is to offer both the public in the sports hall and the TV-viewers uniformity and attractiveness that are a characteristic of our sport. Therefore a uniform and pleasant presentation of the playing area is essential; it includes that the quality and the colour of floor, table and surrounds match.

Furthermore, the necessity of a floor contrasting clearly with the ball ensuring its visibility under all kinds and angles of lighting is fundamental for players, spectators and camera people.

## I Medical and Physiological Criteria

A synthetic flooring system shall be supportive to the practice of table tennis by reducing possible harm to muscles, tendons and joints of the players, resulting in fewer accidents and less injury from accidents and making play less tiring or stressing. The suppleness, shock absorbance, energy restitution and coefficient of friction of the flooring may respond to the specific situation of table tennis play. The floor also should not be so bright or shiny that the player has trouble and getting tired seeing the ball. A sports floor shall not release any volatile organic solvents; neither shall the adhesive tape possibly used for its installation.

## II Sport Criteria

The floor shall permit the athlete to start and stop readily and allow easy rotation of his feet, and as he moves it should not feel slippery or too sticky. The floor shall also permit easy rolling and rotating movements of the wheels of a wheelchair, and its edges and joints shall be able to endure torque and shift initiated by the wheels. This is not simply a matter of designing the surface but also of all over softness and resilience. The floor should not be noisy, and it should not transmit vibrations to the table.

## III Psychological Criteria

The performance of an athlete depends to a great extent on his level of nervous energy and confidence in the facilities. The design of floor should take into account this scientific knowledge. For instance, regardless of the factors of the previous paragraph, the floor mat should not feel so different that the athlete has difficulty adjusting to it or gets mistrustful.

## IV Technical and Financial Criteria

The cost of a floor includes not just the purchase price, but also the ease, time and cost of installation and removal, the cost of repairs and cleaning, and the replacement cost, i.e. durability. The ideal floor will feature a good compromise between cost, performance and longevity.

## V Appearance of the playing surface

A floor mat once laid down shall be and remain flat, regular and continuous; its bands shall touch so that a final floor does not show undulation or gaps which could trap the player's feet or worry him.

A floor may not be glossy; and its haze gloss shall be as low as possible so that its colour shall not be affected by the intensity of the light and the angle of observation.

The table shall not indent the floor in a way that its height is no more regular. Tables and umpire chairs shall not leave permanent marks on the floor mat. Additionally, the floor surface may not show abundant and permanent scuff marks of the player's footwear or traces of adhesive tapes or advertisements.

## VI Inscriptions

The number, the dimension and the location of advertisements on the floor shall observe Regulation 3.2.5.6. for International Competitions. The markings on the floor shall not include the colour of the ball and no white\*, and they shall include not more than 2 colours. Their friction coefficient and gloss shall not be different from those of the flooring surface. The floor supplier shall provide the technical data and instructions how to manufacture, apply and take off advertisements.

**\* Only "nearly" white is allowed: in CIE-La\*b\*-System, L shall be less than 90% for any colour used, but this limit may be adapted in future.**

Together with experts, specialized testing labs and the flooring companies, the ITTF Equipment Committee develops test procedures, which allow a simulation of the requirements of the table tennis sport.

In the present leaflet, the ITTF lays down requirements, recommendations and explanations about flooring in table tennis and describes the documents, data and test results providing the information needed before approval of a floor may be given.

## Criteria for approval

### A. Name of the flooring mat and country of origin markings

Each floor must have a specific name that distinguishes its surface from others. Each floor name may be approved for a maximum of 2 colours, each of 3 thicknesses or under-layers. For floors with an identical surface but with different layers below may keep the same name if its different structure does not confer to the floor properties that are significantly different; the Equipment Committee may decide case by case, and may therefore initiate testing. The underside of the flooring mat must wear the name of the supplier and of the floor at least once per sqm. The top surface may not wear any name or distinctive logo of the supplier (exception see above: regulation 3.2.5.6 for non-permanent markings).

A «**made in <Country>**» marking should be added on the **underside** of the floor together with the company and floor name.

### B. Approval procedure. Data collection

The supplier shall address a letter of application for a new floor to the Equipment Committee and submit by ordinary mail an English version of measurements already achieved by a testing laboratory, of events where the floor has been used and, if possible, a brochure of the company's products. The addresses are published at the ITTF web site.

The ITTF Equipment Committee will submit to the applicant a form which must be filled in and to which all required pictures, documents or data must be added before sending it to back by to the Equipment Committee. One floor sample must be shipped to the Equipment Committee another one to the Testing Institute according to instructions given by ITTF on due time.

Changes at already approved floors must be notified with full details to the ITTF Equipment Committee, which may either authorize them or decide additional testing.

### C. Fees and costs

The ITTF may ask for the prior payment of a testing fee for new or changed floors.

The ITTF will charge an entrance approval fee for the first year and annual renewal fees.

The applicable fee amount may be asked for at ITTF Headquarters.

The ITTF may ask for the reimbursement of shipping, customs or other costs before approval is giving.

### D. Provisional and final approval. Removal from ITTF approved floors list.

Before being finally approved a floor may not only pass the ITTF tests and comply with all other required features; in addition it shall not give cause for justified complaints from players, match officials or organizers during the first 3 years therefore considered as a period of provisional approval. If – at any time - a floor shows to be detrimental to our sport the ITTF Equipment Committee may propose its immediate, final or temporary, removal from the equipment to be used in a table tennis sports hall.

The ITTF may proceed to a satisfaction survey or quality control at any moment.

### E. Data published and protected. Certificate to the supplier.

Once all ITTF requirements are fulfilled,

- the ITTF publishes the approval of the floor on its web site, showing a list of the name, country and web address of the flooring company, the name, colour and thickness of the floor, its direct use on concrete or not as well as pictures or drawings of the floor and its cross section.
- the ITTF delivers a certificate of approval mentioning the name and address of the supplier, the name of the floor, its colour, its thickness, its possibility of use and the duration of approval.

- the ITTF establishes and administers a data-base with all test results or other information; it uses its best endeavours to protect the data from access or revelation to unauthorized persons.

## Specifications and Test Methods

### A Sporting Qualities

The ability of the floor to absorb shock, its suppleness i.e. the vertical deformation in response to a vertical force or impulse and its energy of restitution are properties which will be considered.

Therefore, an impactor including a steel spiral spring (weight 20kg, impacting steel plate of diameter 70mm) is dropped from a certain height of 55mm. The results are recorded and evaluated according to the testing procedure "Triple A" (Advanced Artificial Athlete). The relevant tests are achieved on an under-construction made of styrodur (about 29mm thick, and having a density of 34kg/m<sup>3</sup>) covered by agglomerate (about 19mm thick, having a density of 624kg/m<sup>3</sup>) for all floors thinner than 6mm. For thicker floors the tests are run either on concrete or on the above mentioned under construction or on both according to the use intended.

The magnitude of the shock absorption i.e. the reduction of the impact force by the mat expresses its safety and comfort at the impact of a body falling onto its surface.

The measured reduction of the force at the impact is given as the percentage of a reference impact force of 6760 N which is the calculated maximum impact force on a non-shock-absorbing surface, like concrete. It shall be between 20 and 30% for the above mentioned "Triple A" method.

The (maximum) vertical deformation of the surface under an applied load expresses the suppleness of the mat which governs the ease and safety of walking and running. For a floor, covered or not by a movable floor mat, with a wider reaction (e.g. a wooden or synthetic gymnasium floor, a wooden undercarriage lying on joists and felts, or styropor covered by agglomerate or wood, etc.) the vertical deformation shall be between 1.6 and 2.5mm for the above mentioned "Triple A" method. A floor with a local reaction only (e.g. concrete directly covered with a movable mat or wood) whose force reduction is between 24 and 30% may be acceptable if the vertical indentation is between 1.5 and 2.5mm.

The maximal speed of the impactor at the end of the impact is an expression of the capacity of the floor to return the absorbed energy. The percentage of energy restitution after an impact shall be between 50 and 68% for the above mentioned "Triple A" method. A floor with a local reaction only whose force reduction is between 20 and 25% may be acceptable if the energy restitution is between 48 and 68%.

The bounce of the ball on the floor is not an important criterion.

The above described requirements have been developed for movable synthetic floor mats; for other types of movable springy floors made of wood or synthetic tiles, ITTF – before deciding about acceptability - will consider the entirety of especially the sporting properties, but may also take into account other qualities.

### B Frictional Characteristics

Many of the available synthetic floors seem to have frictional properties that are generally acceptable to most players, but floors nevertheless differ from each other so that the playing

conditions are not the same all over the world. The skidding features of a dry and clean sports floor can be determined by the British Pendulum Tester. The friction pendulum (1.5kg) with a standard rubber slider contacts the floor over a specified distance; the greater the friction, the more swing is retarded. The skid coefficient of a table tennis floor should be between 88 and 98, according to AFNOR 90-106 (nearly identical to ASTM E 30). A higher number implies higher friction. This friction pendulum method has the disadvantage of not working well with profiled floor surfaces. Unfortunately there is no reliable, internationally admitted standardized procedure for measuring the friction of those surfaces. Experiments trying to modify existing test procedures as EN12502-6 are still under way.

The present methods share the disadvantage of defining the friction with respect only to the material of the slider. As shoe soles are made of various natural and/or synthetic materials and have different designs, it is normal that they have different frictional characteristics. Defining the properties of the floor so that it permits good table tennis to be played with any of these types of shoes is a compromising task. It may eventually prove necessary to consider the compositions of both the flooring and the shoe sole (= slider of the test device), but the ITTF purposely does not wish to describe or exclude shoe designs or materials. One problem with synthetic flooring is *scuffing*, as evidenced by visible marks that are inimical to a fine presentation. These marks are the result of wear of the shoe-soles, suggesting that those floor surfaces may be too rough. Such peculiarity may render the floor mat unacceptable for its use in table tennis whatever the result of the friction test may be. (N.B. marks resulting from the wear of soft white rubber soles or of the colouring of black soles which normally are prohibited in sports halls may not disqualify a floor).

### **C Light reflection: gloss and haze gloss**

Gloss compares the intensities of the reflected light and incident light beam at the same angle. High gloss is obviously undesirable at any angle: defensive players can be looking vertically downwards when chopping, and attackers can be looking almost horizontally, as can spectators and cameras, and depending on the position of the lights they may be dazzled.

The (specular) gloss is determined with a gloss meter according to ISO 2813. A gloss of more than 6.0 at 60° is not acceptable. Gloss may not be easily or correctly measured on textured surfaces; a decision may be taken by eye-sight.

Haze gloss describes the intensity of the light diffused in all directions by the floor surface. High haze gloss, especially under strong light, considerably reduces the colour tone to grey or white which is adverse to the efforts to present a colourful table tennis, in the venue, at pictures and at TV, taking into account that our sports uses white, small and speedy balls. There is actually no really satisfying measurement for the haze gloss of floors, but the manufacturers are invited to include pigments into their floor surface which effectively absorb light. A decision may be taken by eye-sight or by an adequate test using a haze-meter.

### **D Uniformity and flatness of the playing surface**

All properties of the floor, including both visual and mechanical, should be uniform over the entire surface. Fastening systems (e.g. Velcro, Adhesive tapes, Glue bonding, Zip-fastener) are acceptable only if durable, if they keep the floor uniform, even and safe and if they are not visually distracting. The floor, once set up and correctly fixed, may stay without any undulation: its thickness and structure as well as the notice of use (rolling up and out, storage, use, cleaning etc.) shall guarantee the best possible result; four hours after rolling out and setting up the flooring at a temperature of 21° to 25°C, it shall be completely flat. A test may be performed accordingly on a floor sample 3m x 1m; 24 hours after being rolled out it shall be flat.

## E Resistance of the floor mat and durability

Any type of movable flooring should be capable of being installed and removed at least fifty times before it has to be discarded. It must be impervious to water. It must withstand the rigours of tournament play of at least 1500 hours. Impressions left by semi-permanent weights, e.g. the legs of a table left on the floor for the duration of a week-long tournament, should be invisible within 24 hours after the force is removed. No undulation tendencies shall appear with age. The floor should be capable of use at any temperature between 10° and 40°C; it should not be embrittled by storage at -20°C, nor damaged by storage at 60°C, nor stiffened at 5°C.

If the flooring is to be installed permanently, it shall meet the above criteria except those referring to installation and removal and to storage. Additionally, it shall be capable of fairly steady use, e.g. in a full time table tennis training centre, for ten years.

The ITTF does not determine abrasion of the movable floors. For floors installed permanently with tables always at the same position a Taber abrasion test may be useful and achieved, and the floor supplier shall provide its result according to EN14904 or a specified similar norm.

The behaviour under a rolling and rotating load is determined by stressing a small part including the critical area, i.e. the joints of 2 floor bands, by the repeated traversing and revolving around a vertical axis of a loaded wheel. The norm EN 1569 is applied, adapted and completed as follows: steel wheel diameter 100 mm, wheel width in contact with floor 30 mm edges rounded by a radius = 1mm, load of the wheel 80 kg, 150 rolling to-and-fro movements at a speed of 1m/s at 10° to the direction of the joint and at 80° to this direction, always on the same small part., 50 rotating movements around a vertical axis at an adequate angular velocity. For this test 2 samples (150cm long, 100cm wide) of the floor will be joined together according to the instructions of the floor supplier. The test institute may decide if a lateral stabilization or fixation is needed. The intended use of the floor will decide if it is tested above concrete or the under carriage as defined under A (Sporting Qualities) After the test, resulting damage is observed and quantified, if possible.

The resistance to rolling will be determined and it may evaluate the floor's suitability for wheelchair table tennis play.

The resistance of the floor to indentation and residual indentation are determined by measuring the depth of penetration of an indenter and by measuring the recovery of the material after 5 minutes and after 24 hours, using the cylindrical steel indenter described in EN 1516 (500N during 5 hours, radius = 25 mm, rounded edges ). This measurement will take place on a rigid structure like concrete at a temperature of 20 - 25°C. The maximum initial indentation shall be less than (to be determined) mm , and the residual indentation after 24 hours shall be less than 0.5mm.

## F Colour

The *colour* of the floor shall provide a good contrast to the colours of the tables and balls, it should not be too bright for players or TV and it should not be too dull for spectators inside a sports hall. Bright red or orange floors do not permit the use of orange balls. The supplier shall provide the colour composition according to the CIELAB system. Colours should be dark with a lightness factor  $L < 40 \%$ . The Equipment Committee may tolerate lightness up to 44%, if the appearance and colour of the surface remains dark. It is reminded that 1 % of the male population worldwide (8 % with a North European ancestry) do not distinguish green and red (Daltonism or Deuteranopia). The ITTF will only list basic or common colour names, but not the manufacturers' colour nuances.

## **G Fire resistance. Chemical, physical and ecological aspects. Instructions for cleaning.**

The supplier must prove that its product complies with the relevant laws and regulations of the market; the ITTF may ask for a certificate of tests passed and its classification regarding the reaction to fire of the floor mat. For the European market the relevant certification shall be according EN 13238 and EN 13501-1, and the minimum class required by ITTF is C<sub>FL</sub>S<sub>2</sub>. The flooring mats must not release volatile organic solvents; a measurement with the MiniRAElite device shall remain under 3.0, both on the underside and on the surface, when run as for the ITTF racket testing.

In order to attribute an identity card to the floor and detect changes in the composition of the surface and in the manufacturing procedure, the ITTF may ask the supplier for the following data issued by a certified laboratory. If they are not provided ITTF may entrust a Testing Institute with the tests and measurements at the supplier's costs.

- a) Shore hardness A of the top layer of the floor mat
- b) Shore hardness A of the complete floor mat
- c) Differential Scanning Calorimetry (DSC): analytical graph of the top layer.

In order to avoid initial slipperiness, the surface of a new floor shall be delivered without wax or similar treatment; the surface shall not require special treatment, except during cleaning. The cleaning procedure shall be achieved with environmentally friendly substances as recommended by the floor supplier. The supplier must provide a detailed description about cleaning operations and products and certify that the recommended products are biodegradable; there shall be separate instructions for normal cleaning and for removing marks from the shoe soles.

The material used for the floor may be recyclable; but this shall not be a criterion for approval.

## **H Under-layer or under-construction**

A thin floor mat, typically up to a thickness of 5mm, only shall be used on an underground with sporting properties, never directly on concrete or tiles. A thicker floor mat may have sporting properties good enough to be used directly on a rigid ground; but it may possibly not be suitable to be used on a sports floor or other supple underground.

If the floor cannot be used directly on a floor not showing adequate resilient properties like concrete, an undercarriage or under-construction introducing the missing sporting features is needed; it may ensure the same properties all over the playing area. This may be an existing sports floor, preferably a combined-elastic sports floor. This may be an under-construction specially designed and set up for the tournament, with a reduced area-elasticity to prevent the table from moving when the player jumps. Such under-construction may be a wooden undercarriage lying on joists and felts. It may be Styropor i.e. expanded polystyrene (28 to 30mm thick) or another similar point elastic material covered by agglomerate or wood (17 to 19mm thick). The pieces of the under carriage shall connect in a way that play does not create horizontal or vertical shifts, and that their junction does not line the synthetic surface floor mat. Additionally, the designer of a floor or an under-construction must take care that it does not produce noise; a thin, soft but tear-proof under-layer directly on concrete may help. For an under-construction using wood or derivatives the supplier shall add a certificate that it does not release formaldehyde (tests EN 717-1 and EN 717-2).

## Conclusion

The ITTF wishes to create a safe, sporting and nice flooring system for all events, and appeals upon the floor suppliers to apply all requirements and recommendations and upon the associations to make good use of the ITTF approved flooring material. Additionally the ITTF recommends that its technical leaflet also will inspire suppliers and users of permanent floors to install a table tennis suitable quality.

The approval of the ITTF will always specify if the floor mat can be used directly on concrete or if it requires a sporting, springy under-layer, as described under A – Sporting Qualities. This information will be given at the ITTF web site under Equipment.

***End of T6***