ITF Court Surface Classification Scheme

ISSSS Technical Meeting
Nyon, October 2002
Introduction
Introduction

- No way to measure performance characteristics and, therefore:
  - For manufacturers to describe their products,
  - For customers to specify their needs.
Introduction

- 1996 – ITF working group.
- Aims of research programme:
  - To identify the key sports performance characteristics of tennis court surfaces,
  - To establish a common system of test methods to evaluate these characteristics.
What to Measure?

Surface Pace = \( \frac{(V_{ix} - V_{fx})}{1 - e}V_{iy} \)

where \( e = \frac{V_{fy}}{V_{iy}} \)
Surface ‘Pace’

Assumptions

- The ball slides throughout impact,
Surface ‘Pace’

Assumptions

- Weight of the ball is ignored...
Surface ‘Pace’

Surface Pace Rating

\[
\frac{(V_{ix} - V_{fx})}{(1 - e) V_{iy}} = \mu \text{ (coefficient of friction)}
\]

\[
100 \times (1 - \mu)
\]

\[
1 < \text{SPR} < 100
\]
Surface ‘Pace’

**Measurement**

- **Realism** – use tennis ball and tennis court surface.
- **Ball speed** – ball must slide during contact with the surface.
- **Validity** – measuring equipment must be accurate and precise.
- **Aerodynamics** – measure close to time of impact.
## Test Ball Specification

<table>
<thead>
<tr>
<th></th>
<th>Test Ball.</th>
<th>ITF Rules of Tennis</th>
</tr>
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<tbody>
<tr>
<td>Type of Ball:</td>
<td>Pressurised</td>
<td></td>
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<tr>
<td>Ball weight:</td>
<td>57.6 +/- 0.3 g</td>
<td>56.7 - 58.5 g</td>
</tr>
<tr>
<td>Ring gauge diameter:</td>
<td>minimum 67.072 mm</td>
<td>minimum 65.405 mm</td>
</tr>
<tr>
<td></td>
<td>maximum 67.865 mm</td>
<td>maximum 68.580 mm</td>
</tr>
<tr>
<td>Forward deformation:</td>
<td>6.413 +/- 0.317 mm</td>
<td>5.588 - 7.366 mm</td>
</tr>
<tr>
<td>Rebound on concrete (mean of five tests):</td>
<td>1.410 +/- 0.010 m</td>
<td>1.346 - 1.473 m</td>
</tr>
</tbody>
</table>
Pre-Compression
Surface ‘Pace’ Measurement
Surface ‘Pace’
Surface ‘Pace’
Surface ‘Pace’
### Surface 'Pace' Measurement

<table>
<thead>
<tr>
<th>Surface</th>
<th>e</th>
<th>f</th>
<th>No</th>
<th>v1</th>
<th>vt1</th>
<th>v1n</th>
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<th>vt2</th>
<th>v2n</th>
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</tbody>
</table>
Surface ‘Pace’ Measurement

Effects of Surface on SPR

Trial

SPR

0 2 4 6 8 10 12

600s

400s

240s

120s

80s

60s
Surface ‘Pace’ Measurement

- **Realism**
  Use ball and court surface.
  $30 \pm 2 \text{ m}\cdot\text{s}^{-1}$ and $16 \pm 2^\circ$.

- **Accurate**
  $\pm 0.005 \text{ m}\cdot\text{s}^{-1}$ and $\pm 0.05^\circ$.

- **Aerodynamics**
  Measurements made immediately before and after impact.
Test Protocol

FIGURE 1
Court Surface
Test Site Positions

Test 2

Test 3

Test 1
## Test Report

<table>
<thead>
<tr>
<th>Test code:</th>
<th>ITF CS/01/01-02-009</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of test:</td>
<td>Laboratory</td>
</tr>
<tr>
<td>Brand name:</td>
<td></td>
</tr>
<tr>
<td>Test Laboratory:</td>
<td></td>
</tr>
<tr>
<td>Client:</td>
<td></td>
</tr>
<tr>
<td>Date of test:</td>
<td></td>
</tr>
</tbody>
</table>

**Prepared by:**  

**Authorised by:**  

**Distribution:**  
Copy 1 -  
Copy 2 -  
Copy 3 -  ITF  

**Issue date:**  

**Average Surface Pace Rating:**  XX.X

---

**IMPORTANT NOTE:**  
This report does not constitute ITF Surface Pace Classification as recognised in the Rules of Tennis.
Test Report - Surface Pace : ITF CS/01/01-02-009

Client:

Test items:

Test date:

Full description of court surface - including manufacturer's reference, the type of supporting layers and their method of attachment:

Manufacturers reference:

Description:

Test Procedure:

1) Tests on site shall be undertaken on a court that is less than four months old. Prior to the tests being made the courts shall be prepared using the manufacturer’s, supplier's or contractor’s approved procedures. The body requesting the testing shall undertake this work.

2) If the testing is undertaken in the laboratory, four samples, each measuring a minimum of 0.5m by 0.5m in area, shall be submitted to the ITF accredited laboratory. The laboratory shall select three samples at random and test each. Where the sample incorporates loose particulate materials the body requesting the tests shall prepare the samples in the laboratory.

3) Unless the surface is designed to be damp/wet when in it's optimum condition, tests shall be made with the surface in a dry condition.

4) On completion of the tests, the ITF Accredited laboratory will complete this report. One copy of the report will be sent to the body requesting the tests and one copy to the ITF. On receipt of this report the company may apply to the ITF for inclusion on the ITF list of classified tennis court surfaces.

5) When commissioning the Surface Pace assessment the company requesting the tests shall provide a detailed specification of the court/surface construction. The information will be included in this report.

6) The ITF Accredited laboratory will retain a reference sample of the surface tested as follows:
   a) When the tests are carried out on synthetic surfaces the company commissioning the testing shall supply one 0.5m by 0.5m sample of the surface to the laboratory. The laboratory shall have responsibility for verifying that the surface tested on site is the same as that offered as a reference sample.

   b) When the tests are carried out on clay or other water bound mineral surfaces the ITF accredited laboratory shall remove 1kg samples of the surfacing and the top 75mm of foundation material. The laboratory shall retain these materials as a reference.

   c) When tests are undertaken in the laboratory one of the specimens actually tested shall be retained, as a reference.
## Test Results - Surface Pace

<table>
<thead>
<tr>
<th>Surface name:</th>
<th>ITF CS/01/01-02-009</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test date:</td>
<td>0</td>
</tr>
<tr>
<td>Humidity:</td>
<td>54%</td>
</tr>
<tr>
<td>Test laboratory:</td>
<td>Laboratory</td>
</tr>
<tr>
<td>Test type:</td>
<td></td>
</tr>
</tbody>
</table>

### PACE TEST 1:

<table>
<thead>
<tr>
<th>Shot 1 (Ball 1)</th>
<th>Shot 2 (Ball 2)</th>
<th>Shot 3 (Ball 3)</th>
<th>Shot 4 (Ball 1)</th>
<th>Shot 5 (Ball 2)</th>
<th>Shot 6 (Ball 3)</th>
<th>Shot 7 (Ball 1)</th>
<th>Shot 8 (Ball 2)</th>
<th>Shot 9 (Ball 3)</th>
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</thead>
<tbody>
<tr>
<td>vh</td>
<td>28.22</td>
<td>29.15</td>
<td>29.01</td>
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<tr>
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<td>8.56</td>
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ISSSS Technical Meeting, Nyon, October 2002
Test Summary - Surface Pace

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ITF CS/01/01-02-009

Temperature: 21°C
Humidity: 54%
Test laboratory: Laboratory
Test type: Laboratory

Test 1

Test 2

Test 3

Summary

Pace Test 1: 45.4
Pace Test 2: 45.1
Pace Test 3: 44.6
Average e: 0.78
Average f: 0.55
Average Surface Pace: 45.0
Standard Deviation: 0.4

ITF Criteria: Slow (0 - 35) Medium / Medium Fast (30 - 45) Fast (40+)

ISSS Technical Meeting,
Nyon, October 2002
<table>
<thead>
<tr>
<th>Laboratory Comments:</th>
</tr>
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<tbody>
<tr>
<td>Although the tests were carried out on laboratory samples the appearance and finish of the test specimens was considered to be representative of the surface when laid on a tennis court.</td>
</tr>
<tr>
<td>The term &quot;surface&quot; defines a tennis court surface as the top (playing) surface and any underlying layers of construction that influence the sports performance (or biomechanical) response of a court. If any elements of the surface's construction change the response, performance and classification of the surface may be different. As such the results detailed in this report only apply to the surface when laid on a rigid (concrete, asphalt, etc.) base.</td>
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</table>

<table>
<thead>
<tr>
<th>Laboratory Recommendations:</th>
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<tr>
<td>The results detailed in this report are considered to be a valid assessment of the Surface Pace characteristics of the product. In __________ opinion the product satisfies the technical criteria required of tennis court surfaces wishing to appear in the ITF's Court Surface Classification Scheme. CST recommend, subject to ITF approval, that __________ is included on the list of classified surfaces.</td>
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Surface Pace Classification
Typical Pace Ratings

Typical ITF Surface Pace Rating for new courts

- Textiles Wet
- Textiles Dry
- Short Pile Wet
- Short Pile Dry
- Medium Pile Wet
- Medium Pile Dry
- Acrylic
- Clay
Surface and Ball Types

Ball Type 1: To be used on Category 1 (Slow) Surface
i.e. clay, unbound mineral surfaces etc

Low bouncing, faster ball

Ball Type 2: To be used on Category 2 (Medium/Medium Fast) Surface
i.e. most hardscourts, cushioned acrylics etc

Medium bouncing, traditional ball

Ball Type 3: To be used on Category 3 (Fast) Surface
i.e. grass, some artificial turf, indoor textiles, wood etc

High bouncing, slower ball
Related Publications
General Issues

- **Not** an approval scheme (e.g. safety).
- Currently have 28 classified surfaces (number increasing).
- Classification is immediate following receipt of application form, test report and payment.
- Classification valid for 3 years.
## Costs

<table>
<thead>
<tr>
<th>Classification Fee</th>
<th>Non-Foundation members</th>
<th>Supporting level &amp; Sponsoring level</th>
<th>General level Foundation members</th>
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<tbody>
<tr>
<td>1st submission</td>
<td>US$2500</td>
<td>US$1500</td>
<td>US$2000</td>
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<tr>
<td>2nd and subsequent submissions</td>
<td>US$1500</td>
<td>US$900</td>
<td>US$1000</td>
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Related Publications

- An Initial ITF
- Study on Performance
- Standards for Tennis
- Court Surfaces
Surface Pace Test

Figure 3: Illustration of Apparatus of Test Method for ITF Surface Pace Rating (ITF CS 01/01)

- Ball Projection cannon
- Photo cell screen 2 to measure ball velocity and angle after impact
- Photo cell screen 1 to measure ball velocity and angle before impact
- Air Compressor
- Test Surface
Surface Pace Test
Other Tests
Other Tests

Criteria for Vertical Ball Rebound (ITF CS05/01)

Figure 11: Classification of Vertical Ball Rebound

Preferred Relative Percentage Rebound (RPR)
Other Tests
Other Tests

Criteria for Shock Absorption (ITF CS 04/01)

Figure 9: Initial Criteria for Shock Absorption of tennis court surfaces.

<table>
<thead>
<tr>
<th>Concrete</th>
<th>Low</th>
<th>Moderate</th>
<th>High</th>
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<tbody>
<tr>
<td>0%</td>
<td>10%</td>
<td>20%</td>
<td>35%</td>
</tr>
<tr>
<td>ENERGY ABSORPTION</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>60%</td>
<td>100%</td>
<td></td>
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</tr>
</tbody>
</table>

ISSSS Technical Meeting,
Nyon, October 2002
Other Tests
Other Tests

Criteria for Slip Resistance ITF CS 02/01

Figure 5: Preferred Range for non-sliding Tennis Surfaces

The maximum variation in value due to any directional pattern, (eg: in textile surfaces) should preferably be less than 10%.
Other Tests

- Traction Apparatus
- Weight
- Test Sole
- Torque Wrench
- Two bushes or single column bush
- Stabilising Frame
- Test Surface
Criteria for Traction (ITF CS 03/01)

Figure 7: Preferred Range for Traction Measurements on Tennis Court Surfaces

Preferred Range for non-sliding Tennis Court surfaces
Other Tests
Other Tests

Criteria for Permeability (ITF CS 06/01)
Figure 15: Classification of Water Infiltration Rate

0mm  10mm  50mm  100mm
LOW  MODERATE  HIGH
Infiltration rate mm/hour
Other Tests
Laboratory Accreditation

Criteria

- Adequate equipment and facilities.
- Quality assurance.
- Experience in sports surfaces.
- Independence.
- ISSSSS member.
Laboratory Accreditation

Procedure

- Letter of application:
  - List of equipment.
  - Organisational structure and staff CVs.
  - Details of experience.
  - List of publications.
  - Membership of professional organisations.
Laboratory Accreditation

Procedure

- Validation of equipment.
- Support of 2 ITF Accredited Laboratories and National Tennis Association.
- Inspection by Accredited person.
Laboratory Accreditation

ITF 1a v ITF 1b Sestee (SPR)

Limits of agreement (95% confidence)
SPR (ITF 1a) between 2.5 less, and 3.1 more, than SPR (ITF 1b)