Test methods for assessing the performance of sports surfaces

By

Alastair L Cox

CSTCROMFORD@AOL.COM

Objectives of today's presentation

- To summaries who and why standards for sports surfaces are developed
- To illustrate the main tests being used
- To highlight some of the limitations of the tests
- To highlight areas requiring further development

CSTCROMFORD@AOL.COM

Why?

- To control the way the game is played
- To provide a suitable playing environment
- To compare surfaces objectively
- To ensure adequate durability

CSTCROMFORD@AOL.COM

Who develops standards?

- National sports governing bodies
- International sports governing bodies
- National / International standards bodies (ASTM, BSI, DIN, CEN etc,)
- Trade associations

CSTCROMFORD@AOL.COM

Current international governing body standards

1986	FIH	field hockey
1990	IAAF	track & field
1995	WBB	bowls
1997	ITF	tennis
2001	FIFA	football (soccer)
2002	UEFA	soccer (European)
2003	IRB	rugby

CSTCROMFORD@AOL.COM

Current national standards

DIN	Germany
BS	UK
OST	Austria
AFNOR	France
	Nordic countries
ASTM	USA
European	CEN (2005/6)

CSTCROMFORD@AOL.COM

Ball - surface interaction

- ball rebound
- ball roll
- pace
- spin

Player - surface interaction

- shock absorption
- deformation
- friction / traction

Durability

CSTCROMFORD@AOL.COM

Selection criteria

- Suitable for lab and site
- Reproducible
- Repeatable
- Available

CSTCROMFORD@AOL.COM

Ball rebound

FIH
ITF
FIFA
UEFA
IRB

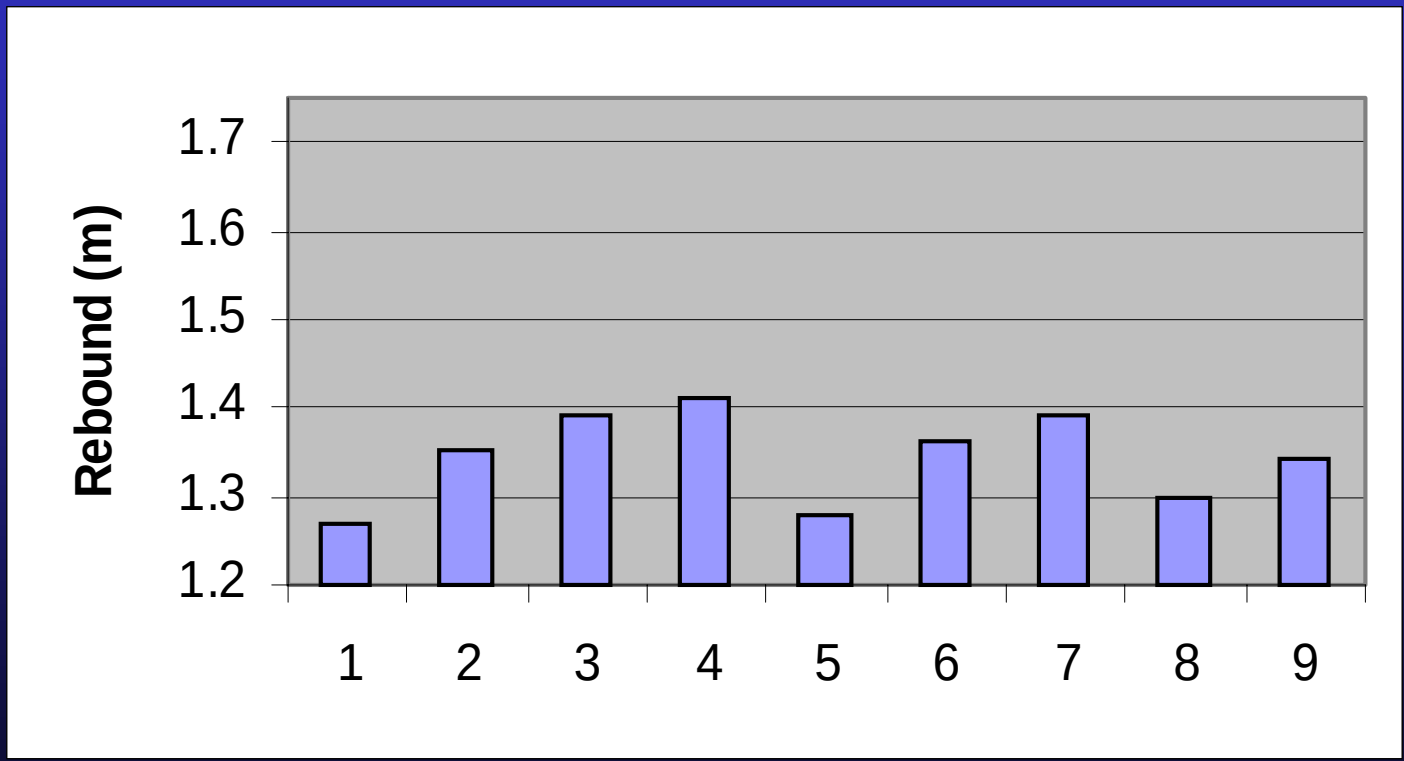
CSTCROMFORD@AOL.COM

Ball rebound - variables

- Ball type
- Drop height
- Rebound measurement

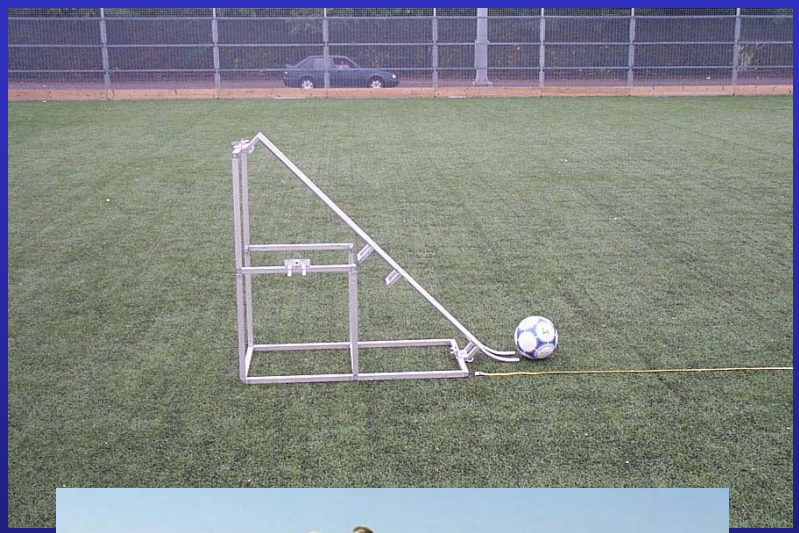
CSTCROMFORD@AOL.COM

Variations in ball rebound



CSTCROMFORD@AOL.COM

Ball roll



FIH
WBB
FIFA
UEFA

CSTCROMFORD@AOL.COM

Ball roll - velocity change

Calculate deceleration (ms^{-2}) over specified distance (DIN)

Calculate change in velocity (ms^{-1}) over specified distance (UEFA)

Calculate equivalent ball roll (FIFA)

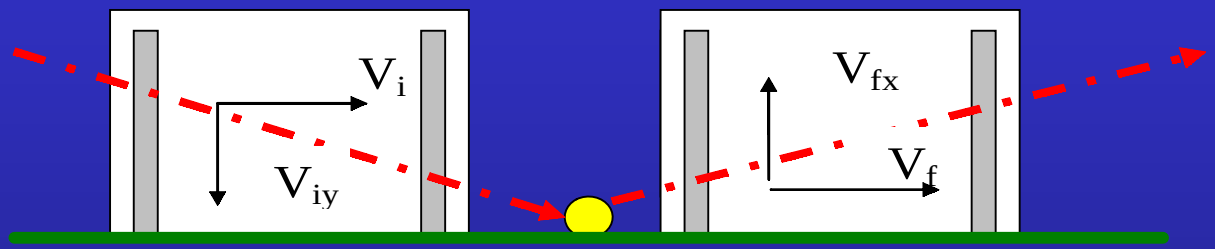
CSTCROMFORD@AOL.COM

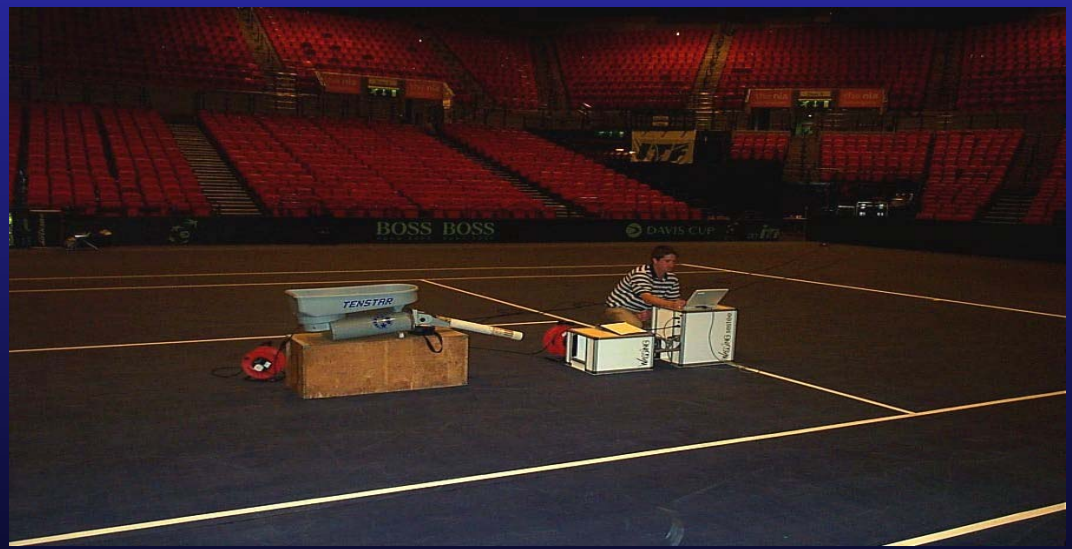
Ball / Surface Pace

ITF
FIFA
UEFA
IRB

CSTCROMFORD@AOL.COM

Tennis Pace



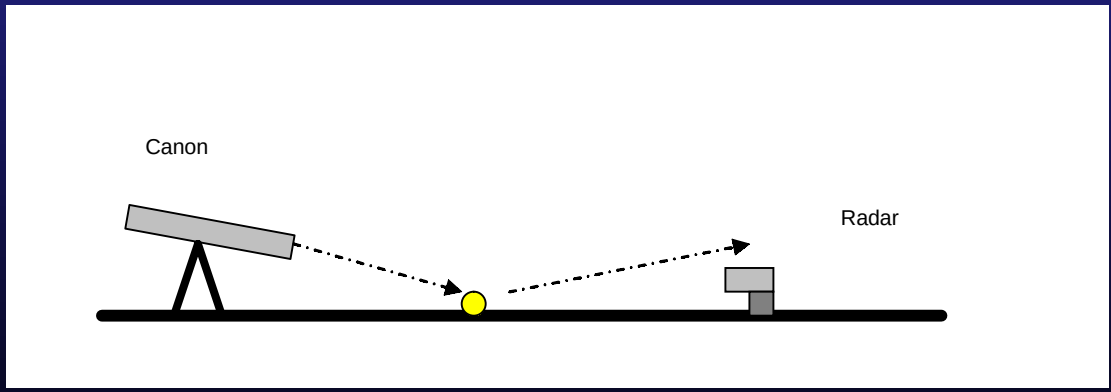


$$SPR = 100 (1- \mu)$$

$$\mu = \frac{Vix - Vfx}{(1 + e) Viy}$$

CSTCROMFORD@AOL.COM

Football Pace



CSTCROMFORD@AOL.COM

Shock absorption

- Force Reduction - Artificial Athlete Berlin
- NSF Sports Floor tester
- HIC & Gmax
- French Foot
- Clegg impact test

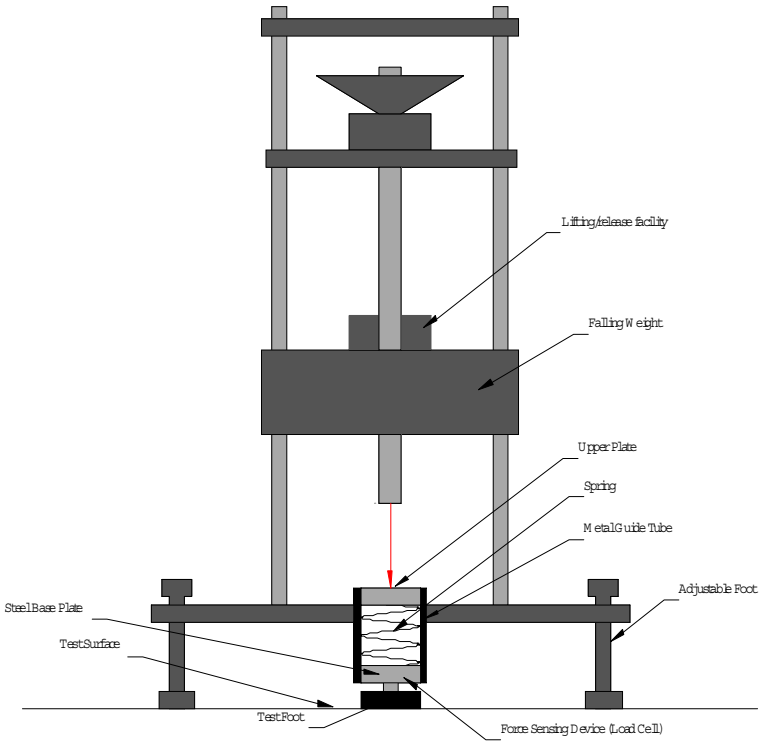
CSTCROMFORD@AOL.COM

Force Reduction

FIH
IAAF
ITF
FIFA
UEFA
IRB

CSTCROMFORD@AOL.COM

Force Reduction



Falling mass = 20 kg
Spring rate = 2000 N/mm
Drop height = 55mm
Force on concrete = 6.60 kN

CSTCROMFORD@AOL.COM

Force Reduction

$$FR = \left(1 - \frac{F_{\max(\text{testpiece})}}{F_{\max\,(\text{concrete})}} \right) \cdot 100\,\%$$

CSTCROMFORD@AOL.COM

Force Reduction

‘Flat foot’

Studded foot

CSTCROMFORD@AOL.COM

NSF Sportfloor Tester

FIH

FIFA

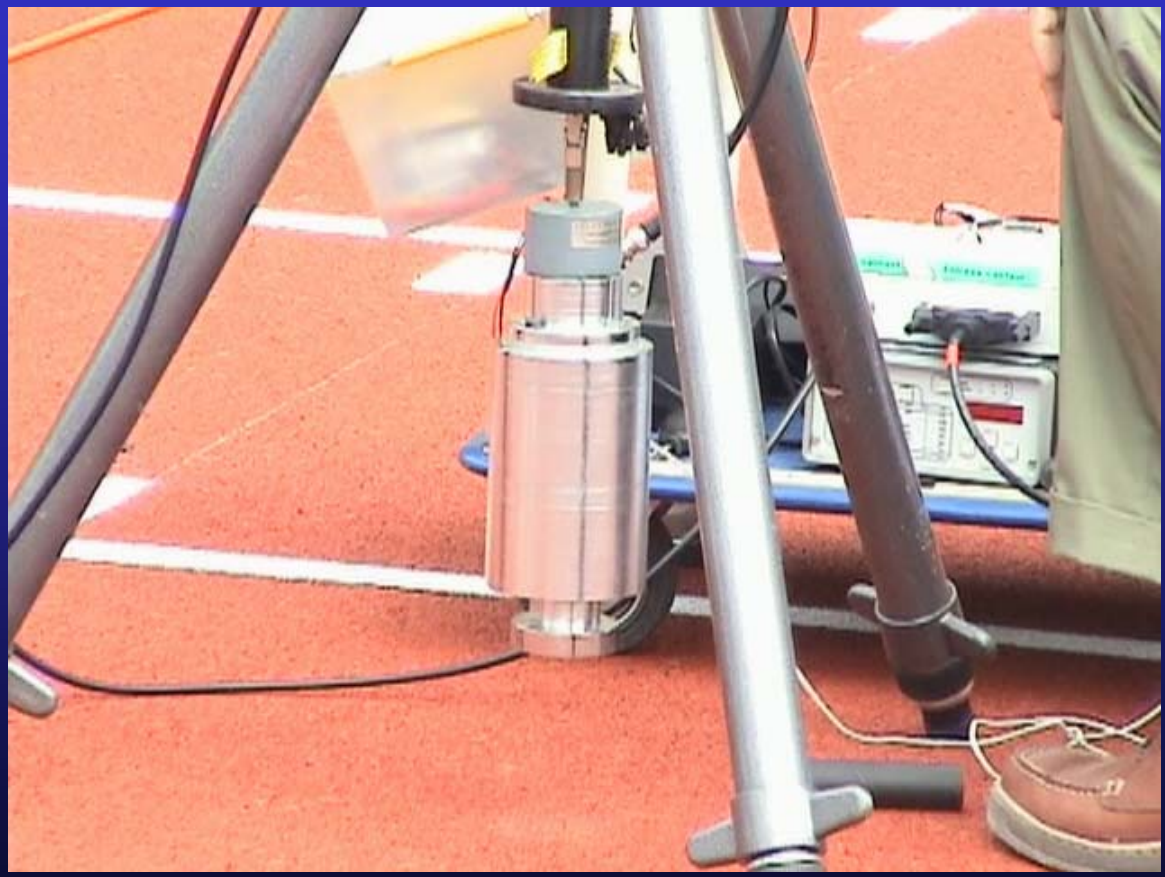
IRB

CSTCROMFORD@AOL.COM

Peak deceleration (BS / ASTM etc)

CSTCROMFORD@AOL.COM

Accelometric method (F & CEN)



CSTCROMFORD@AOL.COM

Clegg impact test

CSTCROMFORD@AOL.COM

Vertical Deformation

- Vertical Deformation - Artificial Athlete Stuttgart
- NSF Sports Floor tester
- French Foot

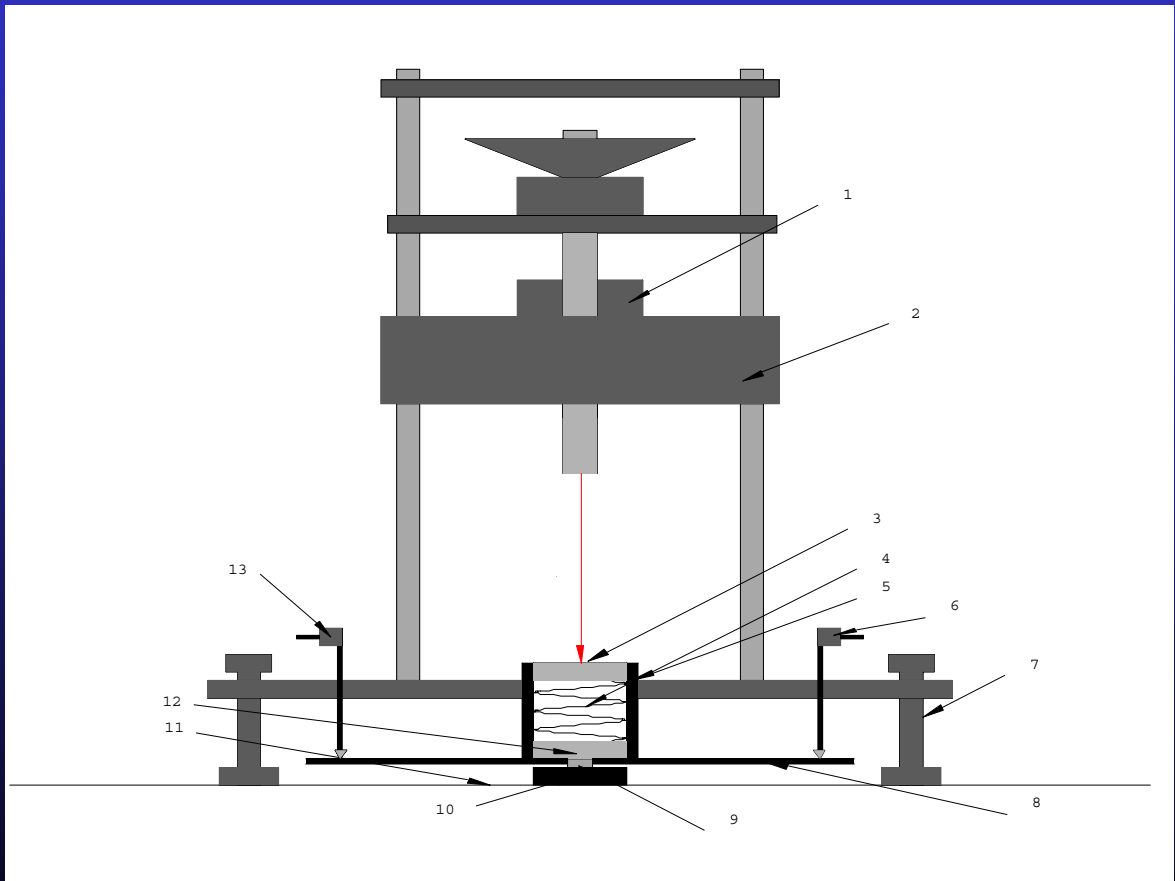
CSTCROMFORD@AOL.COM

Vertical Deformation

IAAF
FIFA
UEFA
IRB

CSTCROMFORD@AOL.COM

Artificial Athlete Stuttgart



Falling mass = 20 kg
Spring rate = 40 N/mm
Drop height = 120mm

CSTCROMFORD@AOL.COM

Vertical Deformation

$$VD = \left(\frac{1500}{F_{\max}} \right) \cdot d_{\max}$$

CSTCROMFORD@AOL.COM

Rotational Friction

WBB
ITF
FIFA
UEFA
IRB

CSTCROMFORD@AOL.COM

DIN friction test

IAAF

CSTCROMFORD@AOL.COM

Slip resistance

IAAF
WBB
ITF

CSTCROMFORD@AOL.COM

Slip resistance

FIH
WBB
FIFA
IRB

CSTCROMFORD@AOL.COM

Sliding properties

CSTCROMFORD@AOL.COM

Conditioning

CSTCROMFORD@AOL.COM

Effects of climate

CSTCROMFORD@AOL.COM

Effects of wear

CSTCROMFORD@AOL.COM

What is missing / being developed?

- Realistic friction tests:
  - Translational
  - Rotational
- Energy restitution
- Spin

CSTCROMFORD@AOL.COM

Acknowledgements

Union of European Football Associations

International Association of Sports Surface Sciences

CSTCROMFORD@AOL.COM