Artificial Athlete Berlin

Hans J. Kolitzus, IST

Original Artificial Athlete Berlin 1968

INSTITUT FÜR SPORTBODENTECHNIK
IST Consulting GmbH
Dipl.Ing. Hans J. Kolitzus

Artificial Athlete Berlin
„1968“ Version

This 1st Artificial Athlete was designed by the Federal Institute of Testing Materials in Berlin (BAM) in the early 60ies. It worked with very low viscous oil which was pressed through wholes in the shaft when the drop weight plunged into the oil pot. The drop weight carried an accelerometer. The peak deceleration was a parameter to describe the shock absorbing behaviour of the surface. It was designed for area-elastic sports hall surfaces. Since it was unpractical for use on site (spilling out of oil) and not suitable on point-elastic surfaces the (Modified) Artificial Athlete Berlin was developed (1975).

INSTITUT FÜR SPORTBODENTECHNIK
IST Consulting GmbH
Dipl.Ing. Hans J. Kolitzus

Artificial Athlete Berlin „1995“ Version

The (Modified) Artificial Athlete was developed with a steel spring as a shock absorbing unit. Since about 1990 the spring is precisely milled with 3 wires to an accurate spring number of 2000 N/mm. The wings on top of the test foot are needed when the mechanical system of the AA Berlin is used to act as an AA Stuttgart.

INSTITUT FÜR SPORTBODENTECHNIK
IST Consulting GmbH
Dipl.Ing. Hans J. Kolitzus

Artificial Athlete Berlin „1995“

Test foot, load cell and spring in detail; problem here is the specification of the spring number and its tolerances. None of the standards addresses this (the force-deformation characteristic is not completely linear).

INSTITUT FÜR SPORTBODENTECHNIK
IST Consulting GmbH
Dipl.Ing. Hans J. Kolitzus

Artificial Athlete Berlin „1995“

Testfoot + Spring assembled

INSTITUT FÜR SPORTBODENTECHNIK
IST Consulting GmbH
Dipl.Ing. Hans J. Kolitzus

DIN Reference Norm

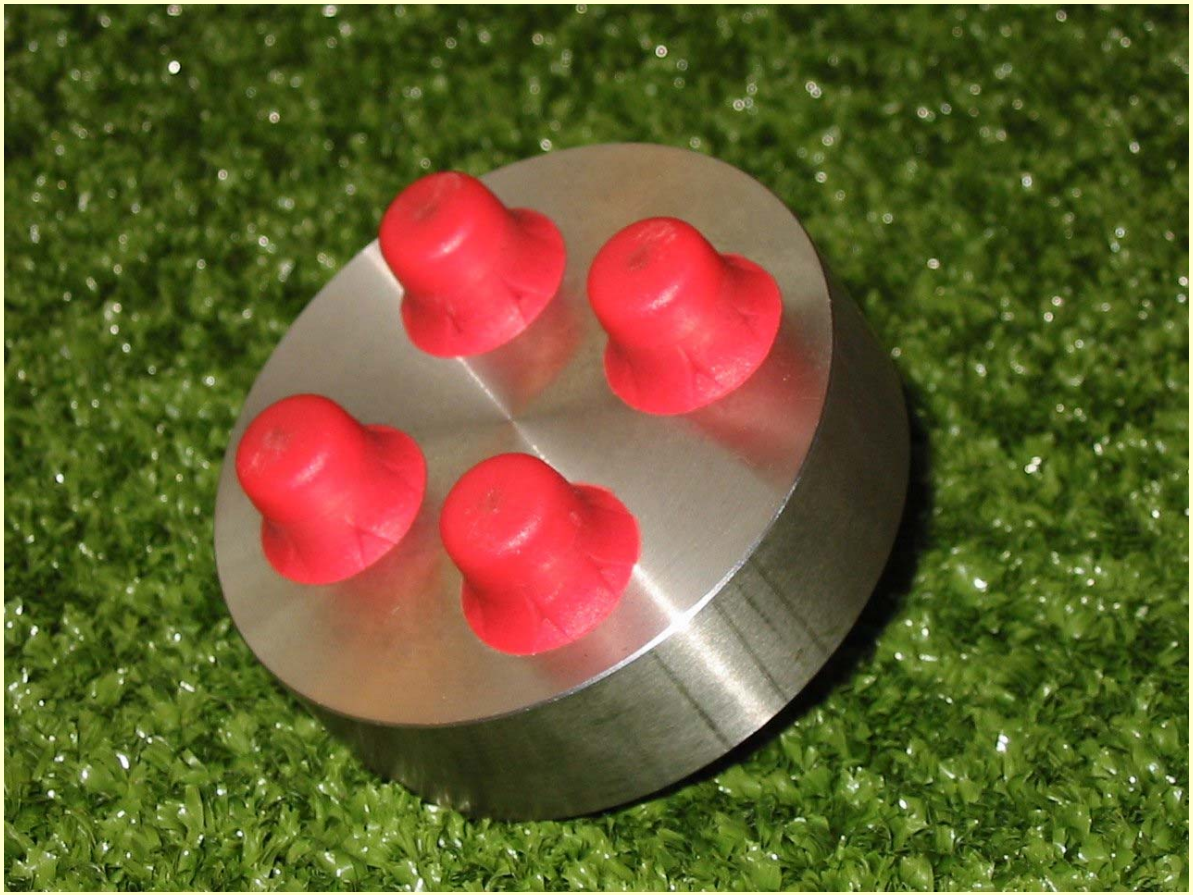
The Reference Norm was initially developed by SKZ for DIN 18032-2 in 1996 as a calibration tool. It is set to have 53% FR by definition. Unfortunately, according to the internationally acknowledged test procedure it has only 50% FR. The reference norm is used as a replacement of a sports surface with known FR.

INSTITUT FÜR SPORTBODENTECHNIK
IST Consulting GmbH
Dipl.Ing. Hans J. Kolitzus

ISSS Reference Norms

The ISSS has improved the design of the Reference Norms and manufactured them with different FR levels (35 - 45 - 55). The reference norms were „calibrated“ by the average of the results of 10 test labs (see referenced documents)

INSTITUT FÜR SPORTBODENTECHNIK
IST Consulting GmbH
Dipl.Ing. Hans J. Kolitzus



Artificial Athlete Berlin „1995“

Studded Testfoot

This is a UEFA specifc test foot. It is unclear what exactly is to be determined in comparison to the flat test foot: stability?

INSTITUT FÜR SPORTBODENTECHNIK
IST Consulting GmbH
Dipl.Ing. Hans J. Kolitzus

Design of Device

	DIN 18032-2 DIN 18035-7 FIH	EN 14808	IAAF	FIFA	UEFA
Spring	recommended to be milled	recommended to be milled	recommended to be milled	recommended to be milled	recommended to be milled
Spring Number	2000 ± 60 N/mm	2000 ± 60 N/mm	2000 ± 60 N/mm	2000 ± 60 N/mm	2000 ± 60 N/mm
Load Cell	10 kN Class 0.1	10 kN Class 0.2	10 kN Class 0.2	10 kN Class 0.2	10 kN Class 0.2
Mass of Test Foot	3.0 ± 0.3 kg	3.0 ± 0.3 kg	3.0 ± 0.3 kg	3.0 ± 0.3 kg	3.0 ± 0.3 kg
Test Foot	Radius 500 mm	Radius 500 mm	Radius 500 mm	Radius 500 mm	Radius 500 mm
Test foot Variant	---	---	---	---	studded

INSTITUT FÜR SPORTBODENTECHNIK
IST Consulting GmbH
Dipl.Ing. Hans J. Kolitzus

Test Realization

	DIN 18032-2 DIN 18035-7 FIH	EN 14808	IAAF	FIFA	UEFA
Number of Impacts	min. 3 until ΔFR <2	3	3	3	3
Waiting Period	1 min	60 s	60 +/ 10 s	1 min +/- 10 s	60 +/- 10 s
Relevant Impacts	last 2	2 + 3	2 + 3	2 + 3	1 = listed 2 + 3

INSTITUT FÜR SPORTBODENTECHNIK
IST Consulting GmbH
Dipl.Ing. Hans J. Kolitzus

Recording

	DIN 18032-2 DIN 18035-7 FIH	EN 14808	IAAF	FIFA	UEFA
Measuring Channel Class	linear 1-1000 Hz (-1 dB)	ISO 6467 >= 1 kHz	ISO 6467 >= 1 kHz	ISO 6467 >= 1 kHz	ISO 6467 >= 1 kHz
Analog Filter	not specified (500 Hz)	not specified	500 Hz	Butterw **2** pole 120 Hz (-3 dB) or	500 Hz
Digital Filter	Butterw 2 pole 120 Hz (-3 dB)	Butterw 2 pole 120 Hz (-3 dB)	Butterw **9** pole 120 Hz (-3 dB)	Butterw **2** pole 120 Hz (-3 dB)	Butterw **9** pole 120 Hz (-3 dB)
Range of Measuring System	not specified	<= 4 times of test reading	<= 4 times of test reading	<= 4 times of test reading	<= 4 times of test reading
Sampling Rate	not specified	>= 2 kHz	>= 2 kHz	>= 2 kHz	>= 2 kHz

INSTITUT FÜR SPORTBODENTECHNIK
IST Consulting GmbH
Dipl.Ing. Hans J. Kolitzus

Calibration

	DIN 18032-2 DIN 18035-7 FIH	EN 14808	IAAF	FIFA	UEFA
Reference Surface	SteelDisk (10mm) glued on top of 200mm Concrete	6.60 ±0.25 kN	6.60 ±0.25 kN	6.60 ±0.25 kN	6.60 ±0.25 kN
Number of Drops	5	11	not specified	11	not specified

Evaluation

	DIN 18032-2 DIN 18035-7 FIH	EN 14808	IAAF	FIFA	UEFA
Name of Device	Künstlicher Sportler Berlin AA Berlin	Procedure 1	Artificial Athlete BAA	Test Method 1	Shock Absorbtion Artificial Athlete
Name of Parameter	KraftAbbau (Force Reduction)	Shock Absorption	Force Reduction	Force Reduction	Force Reduction
Correction Method	Reference Norm set 53 % = RN ΔFR = 53 - FR(RN) %	---	---	---	---
Correction	FRres = FR - ΔFR	---	---	---	---

INSTITUT FÜR SPORTBODENTECHNIK
IST Consulting GmbH
Dipl.Ing. Hans J. Kolitzus

Discrepancy

DIN ./. World

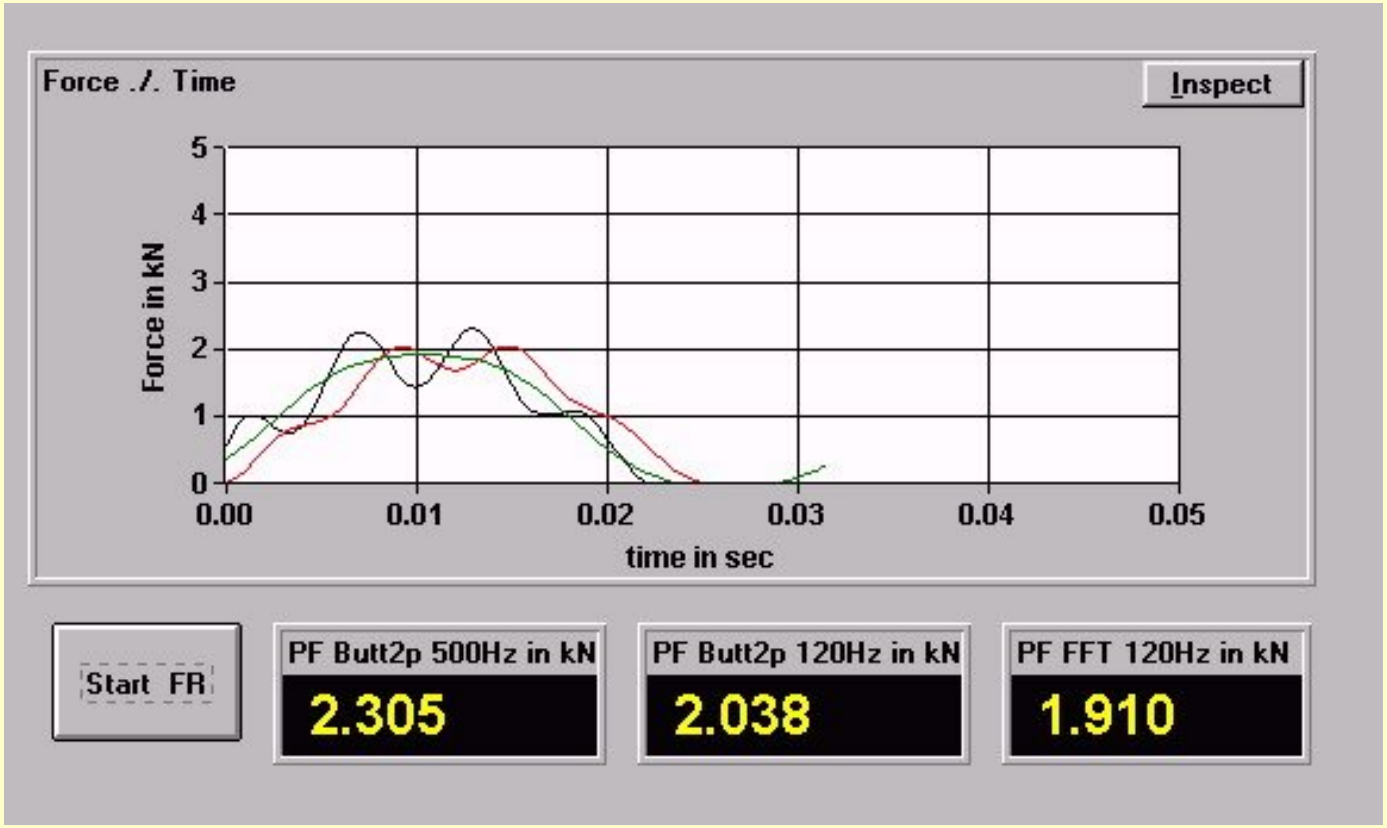
ΔFR = 2.5 - 3.0 %

the „DIN Bonus“

This means that Force Reduction determined in Germany is always 3% (absolute) higher than anywhere else in the world. DIN was notified of this but did not react.

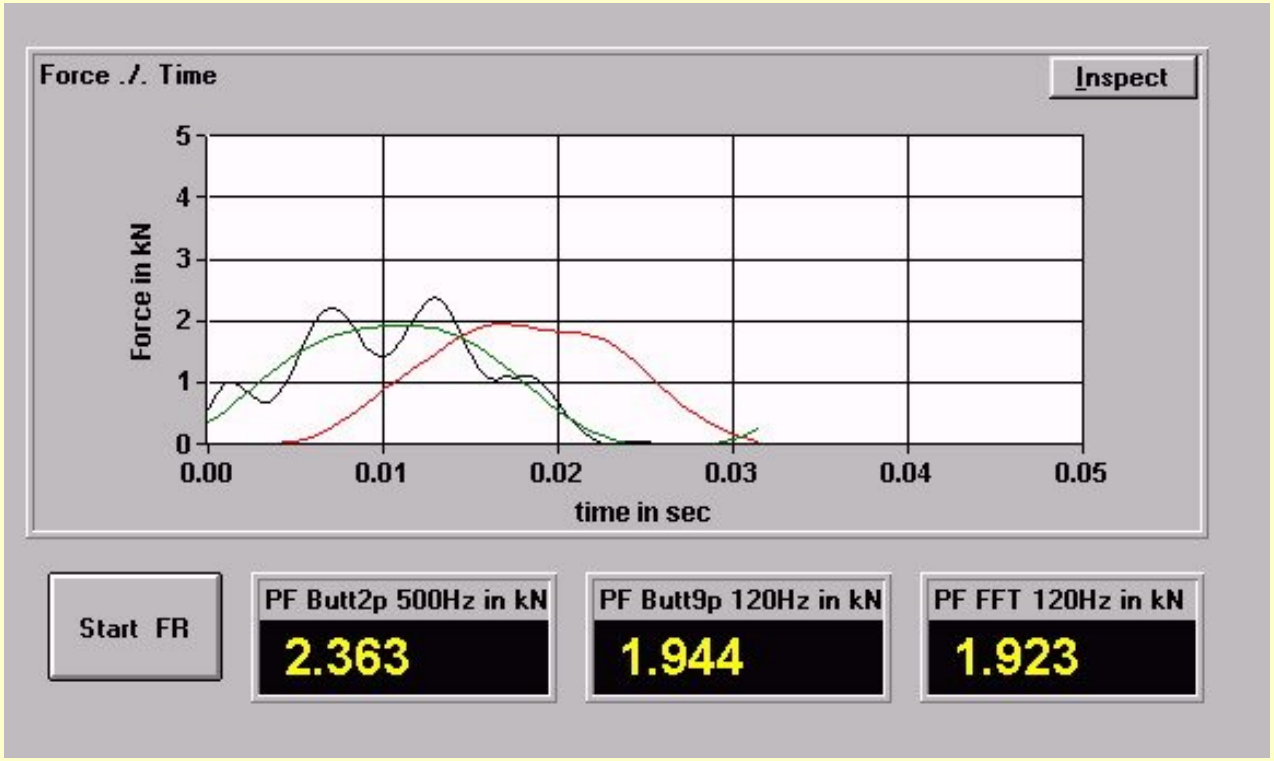
INSTITUT FÜR SPORTBODENTECHNIK
IST Consulting GmbH
Dipl.Ing. Hans J. Kolitzus

Effect of Digital Filter: 2-pole



INSTITUT FÜR SPORTBODENTECHNIK
IST Consulting GmbH
Dipl.Ing. Hans J. Kolitzus

Effect of Digital Filter : 9-pole



INSTITUT FÜR SPORTBODENTECHNIK
IST Consulting GmbH
Dipl.Ing. Hans J. Kolitzus

Effect of Digital Filter

On soft sports surfaces such as synthetic turf, the force response (black) shows an overlaid vibration. This is caused by a resonance effect within the AA and is not a characteristic of the surface. It can be seen from the two graphs that it is necessary to use a 9-pole filter to eliminate the vibration and receive a smooth resulting trace (red). This is important to determine a reliable peak force for evaluation. Although this effect occurs also on FMPA test devices the effect is denied. The 9-pole filter is agreed among all ISSS labs (except FMPA Stuttgart). It should be considered to use an 120Hz FFT filter (green) because it is available on all computerized recording systems and provides best adjustment to the original trace.

Original AA Stuttgart 1968

The drop weight was then 50kg. Here the device is shown when measuring the horizontal deformation.

INSTITUT FÜR SPORTBODENTECHNIK
IST Consulting GmbH
Dipl.Ing. Hans J. Kolitzus

Original AA Stuttgart 1968

Determination of Deformation Trough.

INSTITUT FÜR SPORTBODENTECHNIK
IST Consulting GmbH
Dipl.Ing. Hans J. Kolitzus

Artificial Athlete Stuttgart „1995“ Version (DIN 18032-2:1996)

Drop weight is reduced to 20 kg. In order to achieve the same impact characteristic the drop height and the spring number were adjusted. Thus the same mechanical device can be used for AA Berlin and Stuttgart. The deformation pick-ups in this picture are withdrawn from the AA (actually need to sit on the wings of the test foot). Is it necessary that the spring carries a cap ? No !

INSTITUT FÜR SPORTBODENTECHNIK
IST Consulting GmbH
Dipl.Ing. Hans J. Kolitzus

Artificial Athlete Stuttgart „1995“ Version (DIN 18032-2:1996)

Problem: how to specify the zero-line?

IAAF: release drop weight (20kg) „statically“ on spring, set deformation pick-ups to zero; lift the drop weight and run the test.

Synthetic turf: pre-load 0.01 N/mm^2 which means 3.5 kg caused by test foot.

INSTITUT FÜR SPORTBODENTECHNIK
IST Consulting GmbH
Dipl.Ing. Hans J. Kolitzus