

# Scientific Research Project

## Biomechanical Analyses

at the



## Final Report

## Pole Vault

**Biomechanical analyses of selected events at the  
12<sup>th</sup> IAAF World Championships in Athletics,  
Berlin 15–23 August 2009**

**A Project by the German Athletics Federation**

(© Deutscher Leichtathletik-Verband, Alsfelder Strasse 27, 64289 Darmstadt, Germany)

**in co-operation with**

IAT Leipzig

OSP Berlin

OSP Hessen

OSP Rheinland

Martin Luther-Universität Wittenberg-Halle



**DLV Scientific Research Project**

Deutscher  
Leichtathletik-  
Verband



IAT  
Institut für Angewandte  
Trainingswissenschaft



Olympiastützpunkte  
Berlin  
Hessen  
Rheinland



MLU Halle-Wittenberg

**Report-layout:**

Helmar HOMMEL (DLV)

**Biomechanics-Team:**

Helmar HOMMEL (DLV, Project Co-ordinator • [helmar.hommel@leichtathletik.de](mailto:helmar.hommel@leichtathletik.de))

Marko BADURA (IAT Leipzig)

Dr. Luis MENDOZA (OSP Hessen)

Jörg BÖTTCHER (OSP Berlin)

Ralf MÜLLER (OSP Rheinland)

Dr. Ralf BUCKWITZ (OSP Berlin)

Eberhard NIXDORF (OSP Hessen)

Dr. Olaf ERNST (IAT Leipzig)

Dr. Bettina PERLT (IAT Leipzig)

Dr. Dieter GOHLITZ (IAT Leipzig)

Wilko SCHAA (IAT Leipzig)

Rolf GRAUBNER (Uni Halle)

Falk SCHADE (OSP Rheinland)

Regine ISELE (OSP Hessen)

Axel SCHLEICHARDT (IAT Leipzig)

Mirko LANDMANN (Uni Halle)

Anja STARKE (Uni Halle)

Dr. Frank LEHMANN (IAT Leipzig)

## Pole Vault

*Presented by Bettina Perlt*

Video clips of all jumps have been recorded. The run-up velocities have been measured with the LAVEG1 technology. The measurements and video clips were analysed. The results of our analyses on average speed for defined run-up sections, take-off position and lengths of the two last steps are presented. Sequences of pictures of characteristic jump positions have been composed. Strong and weak features of jumping technique have been identified with the help of these sequences.

### Men

The qualification took place on 20<sup>th</sup> August 2009 under good weather conditions. Two groups of athletes jumped on two pole vault facilities. The Top Ten of 2009 international ranking were among the 35 participants. Seven athletes of Top Ten advanced to the final.

The qualification height was set to 5.75 m as in the Olympic Games 2008. In Beijing the jumping height was increased from 5.15 m via 5.30 m, 5.45 m, 5.55 m up to 5.65 m. This height was cleared by 12 athletes. Invalid attempts were irrelevant. In Berlin the jumping height was increased from 5.25 m via 5.40 m, 5.55 m up to 5.65 m, which was cleared by 11 athletes. Additionally, four athletes jumped over 5.55 m in their first attempt qualifying for the final too.

The final started on 22.8.2009 6:18 pm. The average age of the participants was 27.6 years, which is one year older than the average age 2008 in Beijing (26.2 years). One athlete (R. Mesnil) performed a season's best, two athletes (A. Gripich, D. Dossevi) performed a personal best in the final (table 1).

Table 1: Competition results in relation to season's best 2009 (before the World Championships)

athlete	Platz	SB 2009 [m]	IAAF WCh Berlin 2009 [m]	Difference [%]
<b>Hooker, S. (AUS)</b>	1	5.95	5.90	-0.8
<b>Mesnil, R. (FRA)</b>	2	5.82	5.85	+0.5
<b>Lavillenie, R. (FRA)</b>	3	6.01	5.80	-3.5
<b>Mazuryk, M. (UKR)</b>	4	5.80	5.75	-0.9
<b>Gripich, A. (RUS)</b>	5	5.70	5.75	+0.9
<b>Dossevi, D. (FRA)</b>	6	5.70	5.75	+0.9
<b>Gibilisco, G. (ITA)</b>	7	5.70	5.65	-0.9
<b>Straub, A. (GER)</b>	7	5.81	5.65	-2.8
<b>Lewis, S. (GBR)</b>	7	5.72	5.65	-1.2

<sup>1</sup> Laser operated velocity guard

Table 2 shows the jumping height, the run-up velocity, the number of run-up steps and the take-off position in the men's pole vault event for the 2007 IAAF World Final in Stuttgart and the 2009 World Championships in Berlin (rank 1-8). A comparison with the 2008 IAAF World Final was not possible because the calculated average values of this event were strongly influenced by the early resignation of S. Kucheryanu and D. Yurchenko.

The average jumping height 2009 in Berlin of 5.75 m was the same as 2007 in Stuttgart. This average was similar to the result 2008 in Beijing (5.73 m).

In 2009 the average run-up velocity was equal to 2007. Neglecting the unusually low run-up velocity of 8.73 m/s in one attempt when calculation of average run-up velocity this average increased to 9.24 m/s. This result is still 0.12 m/s lower than the average of the run-up velocity in the 1993 World Championships in Stuttgart (9.36 m/s).

The take-off position was on average 23 cm more remote from the cut-in box. This trend is positive, as it could be an indicator to go for higher grips. Attention should be paid to R. Lavillenie's take-off position which was unusually far from the cut-in box (4.65 m). R. Lavillenie showed his jumps with so-called free take-off.

Table 2: *Jumping height, run-up velocity  $v_A$  in section 11-6 m, number of run-up steps AS and take-off position AP*

IAAF World Final 2007 in Stuttgart					IAAF WCh Berlin 2009 [m]				
athlete	height [m]	$v_A$ [m/s]	AS	AP [m]	athlete	height [m]	$v_A$ [m/s]	AS	AP [m]
Walker, B. (USA)	5.91	9.36	18	4.15	Hooker, S. (AUS)	5.90	9.24	18	4.35
Otto, B. (GER)	5.86	9.28	18	3.65	Mesnil, R. (FRA)	5.85	8.99	18	4.15
Hooker, S. (AUS)	5.81	9.14	18	3.85	Lavillenie, R. (FRA)	5.80	9.54	20	4.65
Ecker, D. (GER)	5.81	9.21	18	3.60	Mazuryk, M. (UKR)	5.75	9.12	18	4.30
Yurchenko, D. (UKR)	5.70	9.36	20	4.45	Gripich, A. (RUS)	5.75	8.73	16	4.25
Hartwig, J. (USA)	5.70	9.16	18	4.05	Dossevi, D. (FRA)	5.75	9.35	20	3.60
Lobinger, T. (GER)	5.60	8.87	18	3.80	Gibilisco, G. (ITA)	5.65	9.07	18	4.25
Pavlov, I. (RUS)	5.60	9.03	18*	4.35	Straub, A. (GER)	5.65	9.35	18	4.20
					Lewis, S. (GBR)	5.65	9.24	18	4.25
<b>Average</b>	5.75	9.18	18.25	3.99	<b>Average</b>	5.75	9.18	18,22	4.22

\* the velocity has been deduced from the velocity of the other jumps because a direct measurement was not possible due to disturbances



## DLV Scientific Research Project

Deutscher  
Leichtathletik-  
Verband



Olympiastützpunkte  
Berlin  
Hessen  
Rheinland

MLU Halle-Wittenberg

### Women

The qualification with 31 participants took place on 15<sup>th</sup> August 2009 under good weather conditions. Two groups of athletes jumped on two pole vault facilities. Eight participants were among the Top Ten of 2009 international ranking. All of these reached the final.

The qualification height was set to 4.60 m as in the Olympic Games 2008. In Beijing the jumping height was increased from 4.00 m via 4.15 m, 4.30 m, 4.40 m, 4.50 m up to 4.60 m. This height was cleared only by E. Isinbaeva as her first height. The other participants advanced the Olympic final with 4.50 m in the first or second attempt. In Berlin the jumping height was increased from 4.10 m via 4.25 m, 4.40 m, 4.50 m up to 4.55 m. This height was cleared by 11 athletes. K. Gadschiew jumped over all heights up to 4.50 m in her first attempt and qualified for the final as number 12.

The final started on 17.8.2008 6:51 pm. The average age of the participants was 26.3 years which is slightly younger than the average age 2008 in Beijing (26.7 years). Only one athlete performed a season's best in the final (table 3).

Table 3: Competition results in relation to season's best 2009 (before the world championships)

athlete	Platz	SB 2009 [m]	IAAF WCh Berlin 2009 [m]	Difference [%]
<b>Rogowska, A. (POL)</b>	1	4.80	4.75	-1.0
<b>Johnson, C. (USA)</b>	2	4.60	4.65	+1.0
<b>Pyrek, M. (POL)</b>	2	4.78	4.65	-2.8
<b>Spiegelburg, S. (GER)</b>	4	4.70	4.65	-1.0
<b>Murer, F. (BRA)</b>	5	4.82	4.55	-5.6
<b>Dennison, K. (GBR)</b>	6	4.58	4.55	-0.7
<b>Polnova, T. (RUS)</b>	7	4.56	4.40	-3.5
<b>Battke, A. (GER)</b>	7	4.68	4.40	-6.0

Table 4 shows the jumping height, the run-up velocity, the number of run-up steps and the take-off position in the women's pole vault event for the 2008 IAAF World Final in Stuttgart and the 2009 World Championships in Berlin (rank 1-8).

E. Isinbaeva has dominated the women's pole vault for several years. Her jump parameters are missing for both competitions. In Stuttgart she was injured and in Berlin she did not clear first jumping heights of 4.75 m and 4.80 m. 11 days after the World Championships final she jumped a new world record with 5.06 m in the IAAF Golden League in Zurich. This should be taken into account when rating of the average jumping height in Berlin. The missing progress in 2009 cannot only be explained by the withdrawal of E. Isinbaeva. Even by considering a jump over 5.06 m only an average jumping height of 4.66 m would have been reached. This average is also lower than the average jumping height in Beijing 2008 (4.74 m).

Compared to 2008 in 2009 the average run-up velocity was 0.24 m/s higher. E. Isinbaeva's run-up velocity in the qualification was 8.28 m/s. This value is within the range of average run-up velocity.

The length of the run-up was one step shorter and the take-off position was about 12 cm closer to the cut-in box.

Table 4: *Jumping height, run-up velocity  $v_A$  in section 10-5 m, number of run-up steps AS and take-off position AP*

IAAF World Final 2008 in Stuttgart					12. IAAF WCh 2009 in Berlin				
athlete	height [m]	$v_A$ [m/s]	AS	AP [m]	athlete	height [m]	$v_A$ [m/s]	AS	AP [m]
Spiegelburg, S. (GER)	4.70	8.05	16	3.85	Rogowska, A. (POL)	4.75	8.68*	16	3.45
Feofanova, S. (RUS)	4.70	8.28*	17	3.90	Johnson, C. (USA)	4.65	8.32*	16	3.35
Pyrek, M. (POL)	4.70	7.76	16	3.70	Pyrek, M. (POL)	4.65	7.92	16	3.75
Golubchikova, Y. (RUS)	4.50	8.20*	18	3.60*	Spiegelburg, S. (GER)	4.65	8.33*	16	3.80
Polnova, T. (RUS)	4.50	7.69	17	3.85	Murer, F. (BRA)	4.55	8.26	16	3.85
Hingst, C. (GER)	4.50	7.87	18	3.55*	Dennison, K. (GBR)	4.55	8.24	14	3.40
Murer, F. (BRA)	4.50	8.06	16	3.75	Polnova, T. (RUS)	4.40	7.68	17	3.80
					Battke, A. (GER)	4.40	8.43	16	3.55
<b>Average</b>	4.59	7.99	16,9	3.74	<b>Average</b>	4.58	8.23	15,9	3.62

\* the velocity has been deduced from the velocity of the other jumps because a direct measurement was not possible due to disturbances