



Markus Rehm

LONG JUMP
WORLD RECORD HOLDER
AND TEAM ÖSSUR ATHLETE



German athlete **Markus Rehm** jumped a world record breaking 8.62m in the long jump event at the 2021 European Para Championships in Bydgoszcz. Having lost his leg below the knee following a wakeboarding accident at the age of 14, Markus began competing in track and field in 2008. In addition to being a world class athlete, Markus is also a practicing prosthetist in Germany.

The Science of "Blade Jumping"

How Amputee Athletes Perform the Long Jump with a Prosthesis

Fast running speed is important to achieve longer jump distances, which is why the best sprinters may also excel as long jumpers. To achieve maximum distance, athletes want to maximize both horizontal and vertical velocity.

Long Jump World Record holder Markus Rehm has recorded a running speed of 10.1 meters per second.

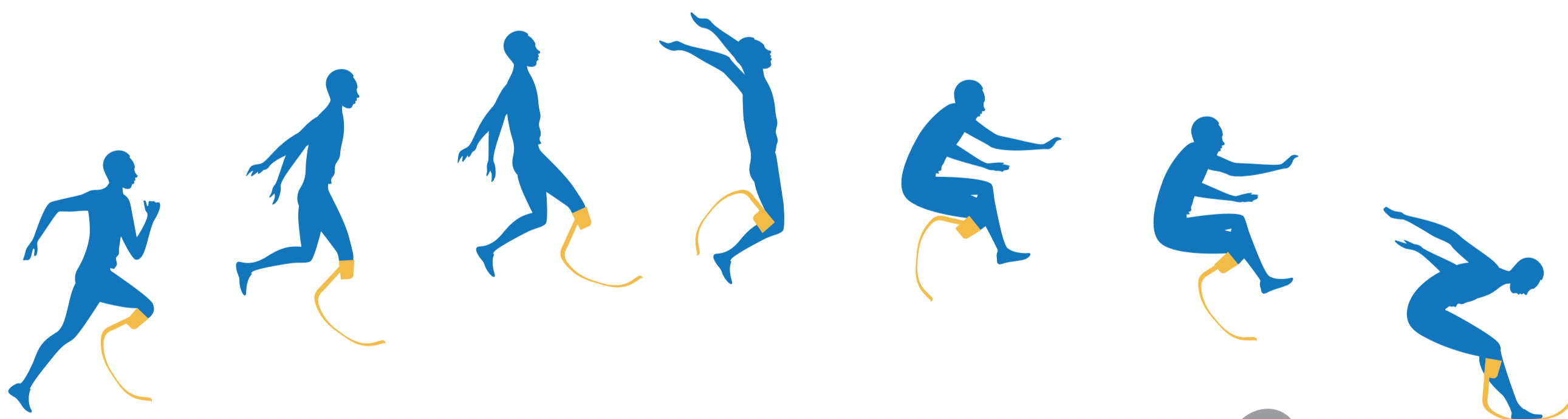
Rehm's current World Record of 8.62m translates to approximately 28.28 feet



Horizontal velocity at take-off is generated by the speed build-up during the athlete's run-up.

Vertical velocity is created by pushing off the ground with the take-off leg. Markus Rehm's contact time has been measured as 118 milliseconds. The greater the vertical velocity, the longer the athlete remains airborne, increasing the jump distance. Markus Rehm's vertical force has been measured as 5 kN and his horizontal force is approximately 1.2 kN. Markus Rehm's Height of CoM (center of mass) from the ground during jumping is 1.6m (approximately 5'3") from the ground at its maximum height. To further maximize their jumping distance, the athlete may raise and then extend their legs so they fall further upon landing.

The long jumper tends to lose some horizontal velocity as they conclude their projectile motion and complete their jump. Markus Rehm's horizontal run-up speed at touch-down has been recorded as 9.32 meters per second.



Able-Bodied Running Vs. "Blade Running"

Developments in carbon fiber running-specific prostheses have allowed individuals with lower extremity amputations to regain the functional capability of running. Össur's Cheetah is a high-performance carbon composite prosthetic sports foot that was designed to enable amputee athletes to optimize their performance. Since its introduction in 1996, the Cheetah has been the "gold" standard in prosthetic feet for elite and recreational amputee athletes worldwide.





Cheetah® Xpanse

For nearly three decades, the innovative Cheetah prosthesis has been the “gold standard” for world-class Track and Field para athletes.

Össur’s new Cheetah Xpanse sports prosthesis is one of the latest in the company’s legacy of innovative sports prostheses. The Cheetah Xpanse was specifically designed for long jumpers and other athletes who subject their prosthesis to an exceptionally heavy load.

The Cheetah Xpanse’s streamlined appearance and strong geometric shape were intended to help withstand the action and energy return that typically occurs upon impact during take-off.



Do prostheses provide any “technological advantage” over able-bodied limbs?

Following an extensive exploration of prosthetics technology and long jumper para athletes, an international panel of biomechanical experts has concluded that passive sports prostheses generate no technological advantage for an amputee long-jumper. A passive technology, the blade generates no energy on its own, nor does it provide its user with any sensory feedback or allow for any control, flexing capability or change in stiffness. All of these factors contributed to the panel’s conclusion that prostheses present no meaningful advantage for amputee athletes over able-bodied competitors.

Vertical force

5 kN

Horizontal force

1,2 kN

Contact time

118 ms

Current Long Jump Records

World Record:
Mike Powell (USA):

8.95m (1991)

World Record:
Galina Chistyakova (URS):

7.52m (1988)

Para World Record (F64):
Markus Rehm (GER):

8.62m (2021)

Sources: “Biomechanical comparison of the long jump of athletes with and without a below the knee amputation” Institute of Biomechanics and Orthopaedics, German Sport University Cologne, Germany; Human Informatics Research Institute, National Institute of Advanced Industrial Science and Technology, Japan; Applied Biomechanics Lab, University of Colorado Boulder, USA, 2018. “Elite long jumpers with below the knee prostheses approach the board slower, but take-off more effectively than non-amputee athletes,” Willwacher et. al, NATURE, Jan. 2017 <https://www.real-world-physics-problems.com/physics-of-jumping.html>