

AXIS CRANKS – a leading edge technology

The **AXIS CRANK®** system is for collecting bicycle torque and force vector data .. It consists of two measuring cranks fitted with strain gages and mounted on both sides of the bicycle. Measurement of the important torques and forces in the crank arm (*rather than the pedal*) allows use of the cyclist's own pedals.

A linear stroke potentiometer is mounted on the bicycle bottom bracket and measures the simultaneous crank angle. The system collects and logs the bi-lateral data representing the independent contributions of left and right leg force. The parameters logged are crank torque, the orthogonal force vector F_{radial} and the simultaneous crank angle. Signals from the two cranks are synchronised with the crank angle data and transmitted to a data recorder. The primary sampling frequency of the force signals in each crank is 250hz.

Crank

The measuring cranks available with adjustable length: or if fixed any length in the standard range can be specified. The cranks will accept any standard pedal with 9/16 x 20 tpi threads. The cranks are supplied with a high strength Stainless Steel Phil Woods Square Taper Bottom Bracket set. Integrated inside each crank is battery powered electronics to make the measurements and compile the data. The battery life expected is a few hundred hours of actual use. Field checking of calibration is done with a weight hung from the pedal. Both crank-arms are calibrated at the same time with a weight hung from each pedal. The cranks are fully machined from 7075 aluminium, an aerospace grade and one of the strongest aluminium types. The design crank stress is low allowing measurements of the strongest riders.

Interface

The AXIS crank system is primarily a real time system, but can also be used in a post analysis situation by reading the on board SD storage card.

The interface is mounted on the bottom bracket to collect the independent force data from each crank and coordinate it with the crank angle. It can be used either in laboratories on an ergometer or in the field in limited use on a normal bicycle.

In the laboratory the composite data is transmitted direct to the computer in real time via USB. Simultaneously it is also logged to a standard SD storage card.

In the field the SD card data storage stores the crank force data of the AXIS cranks. This SD card is removable and readable by any compatible PC. With the AXIS system the cranks can be fitted to either a track bike or a road bike and independent data from left and right cranks measured.

Bio-mechanical analysis

The crank measures the main set of orthogonal crank forces in polar coordinates, crank torque ($F_{\text{tangential}} \times L$) and the crank axial force, F_{radial} . Since the crank angle is also recorded simultaneously then the force basis in polar coordinates is easily transformed to a rectangular basis to derive the vertical and horizontal components of pedal forces **Fz** and **Fx**.

Sensitivity of measurements

The two components of the force vector, F_{radial} and $F_{\text{tangential}}$ are also sometimes referred to as **F_{eff}** and **F_{ineff}** . The $F_{\text{tang}} \times L$ component is the torque and has a primary resolution of better than 1Nm at 250Hz. The resolution is much better at 100Hz sampling. The F_{rad} component is the crank axial force and has similar resolution to torque measurement enabling accurate

resolution of force vectors in space. Crank angle is recorded simultaneous with the forces to about 1 deg.