The Electronic C-Leg® Knee Joint System

Otto Bock Health Care introduced the C-Leg® microprocessor-controlled knee-shin system to Canada in 1997 and to the United States in 1999.

The C Leg is about 13 pounds of Titanium, wires, and circuitry.

The C Leg adds fluid control units to a knee frame, which helps to control the swing phase. The pneumatic or hydraulic fluid-controlled knee prosthesis has pistons that adjust the swing phase resistance as gait changes. Pneumatic control cylinders contain compressible air, and hydraulic dampers contain silicone oil to control cadence. Knee resistance responds automatically to changing walking speeds. Multiple sensors record information 50-times per second - real time. The knee angle sensor provides data for dynamic control of swing phase based on whether the wearer is slowing down or speeding up. A force sensor in the shin uses toe and heel loading data to determine when it is safe and efficient to move out of stance phase, allowing for the free swing of the leg while being supported on the other limb. The result is increased stability, ease of swing, and greater efficiency with every step.

The electronic system is monitored via a software program that is stored in the on-board microprocessor. This program coordinates all measuring and control functions. Angles and moments are measured every 20 milliseconds and are then processed by the microprocessor to compare the data with the patterns of dynamic gait.

The C-Leg® is a monocentric knee joint composed of the following elements: carbon fiber frame, providing the supporting structure and housing for hydraulics with servo-motor and electronics, distal tube clamp, upper joint section with pyramid for socket connection, and shin tube adapter with integrated strain gauges. A C-Leg® version with thread allows the fitting of patients with particularly long residual limbs up to knee disarticulation amputees mode, which allows, for example, to stand with knee joint locked or in defined flexion limitation, or to bike.

A Lithium-Ion battery, located within the knee axis, provides enough energy to operate the C-Leg® for one full day. The knee vibrates and beeps to let you know when the battery is low. It takes 2 hours to fully recharge and 15min. for 5 hours of usage. If the battery dies the C leg defaults to a straight leg position.

Pneumatic and hydraulic prosthetic knee joints enable the amputee to demonstrate a comfortable gait and a wide range of walking speeds. By adding a microprocessor to the pneumatic and hydraulic prosthesis, the amputee’s walking style may be improved. The microprocessor controlled knee-shin prosthesis electronically controls the prosthesis through the stance and the swing phase, allowing increased safety and speed on even and uneven surfaces, as well as on stairs.