

■ Otto Bock (USA), Plymouth, Minnesota

# Sitting Comfortably

| Otto Bock boosts fit and comfort of orthotic devices with Sinumerik CNC.



Custom contoured seating being milled from soft foam in four-axis movement

The manufacture of prosthetic and orthotic devices is a specialist field with particular demands. Each item has to be custom-made for the user and accurate modeling is necessary for the comfort of the wearer. Otto Bock, a leading supplier of prostheses and orthotic devices based in Germany, produces a wide range of products from orthotic support seating to various prosthetic shapes, cosmetic covers and neck-to-pelvis body jackets.

## Laser replaces plaster

Many of Otto Bock's products are made from very large blanks of specially-formulated and costly material. The traditional technique for producing these items was that a plaster cast would be made, then that mold would be used to reverse engineer the cutting path on a router. This approach suffered from being very slow and imprecise. Consequently, Otto Bock developed the OBSS, Otto Bock Seating System. In the OBSS, the patient is seated in something similar to a bean bag chair, the bag is then evacuated and the bag surface is digitized, using Otto Bock proprietary software, developed in cooperation with Polhemus, originators of the FasTrack 3D contact laser scanning system. The digitized data is then used to generate tool path programs for Bornemann robotic five-axis milling machines which carve the orthotic support from solid material. This process, requiring the use of extremely complex machine programs, was made possible by the use of the latest Sinumerik 840D CNC software.

Otto Bock currently has two Bornemann machines at its facility in Plymouth, Minnesota producing prostheses and seat cushions for supply to prosthetists and orthotists throughout North America. For the previous ten years, Otto Bock used ABT carvers, which mirrored its operation in England and Thermwood routers for its foam products. The challenge was to remain flexible in manufacturing, given the constant flow of one-off work. It was critical to have machines that will not only run efficiently, but also have the flexibility for fast changeover and interpolation of large data files. This led to the cre-

ation of an alliance with Bornemann for the development of carving technology, utilizing the latest CNC protocols.

### Milling a perfect fit

The Bornemann carvers, each equipped with Sinumerik 840D CNC technology, are used to cut proprietary rigid and flexible polyurethane foams into the seat cushions used to support spinal injuries, as well as the various upper and lower limb prosthetic devices and supports produced at the Otto Bock facility. Otto Bock's unit in England provides the software used to capture the patient's particular characteristics, such as limb length, circumference and degrees of soft tissue containment. It is critical

helical interpolation – or many other state-of-the-art functions. The universal interpolator, NURBS, enables the interpolation of nearly anything – measured points, freeform surfaces, any curve that can be described mathematically (parabola, hyperbola, ellipse etc.). NURBS performs the control, internal motion guidance and path interpolation together with complicated arithmetic and programming tasks. Integration of B-splines into the control, given that they form the basis of most CAD systems, is simple. These functions make Sinumerik 840D ideal for the complex modeling required by Otto Bock.

The machine operators at Otto Bock generally do not require extensive G-code programming skill as the program is directly downloaded to the NCU on-board the Siemens CNC. Since the part programs



The five-axis milling robot designed by Bornemann uses the Sinumerik 840D CNC to allow versatile carving/milling operations

to have the data accurately interpolated into the tool path for cutting these blocks of foam and rigid materials. An analogy would be the aerospace industry and the contours of a wing. Because the human body has no straight lines, the movements of the cutting tool are extremely complex machine programs. Through the use of advanced, clean and non-invasive laser scanning technology, an extremely accurate image can be made of the patient's torso from the seat bag surface used to initiate the design process. Once the prosthetist or orthotist collects the data, Otto Bock's fabrication software support engineers translate the CAD information through ProfiCAM into the Windows-based, CNC machining program. Otto Bock recently upgraded the NCU/PCU for its Sinumerik CNCs to accept the most advanced version of this translation.

### Complex 3D modeling

The system software of the Sinumerik 840D contains a wide range of unusual NC functions that are not often found in comparable NC controls. For example, it is possible to interpolate using a variety of different methods: linear, circular, spline, polynomial or

**“We could never have achieved these levels without the Bornemann machines and Siemens CNC technology.”**

*Otto Bock vice-president Bill Clover*

are usually quite large, they run directly from the NCU on the machine. Compared to the old tool path generation method, the same path that took two to three hours now takes around 10 minutes using Sinumerik 840D.

A wheelchair cushion that used to take 90 minutes to manufacture on the old system, takes Otto Bock less than 20 minutes to produce. In terms of overall productivity, a typical month's seat cushion output was once about 20, but is now averaging about 250.

If adjustment of the tool paths or cutting speeds is deemed necessary during the run cycle, the Sinumerik 840D can accommodate such changes, in process. This allows the operator to make corrections at any time and at any point in a finished program, dispensing with the need for separate programming workstations.

Using the Bornemann five-axis milling machines and Sinumerik 840D, Otto Bock has been able to boost production and, at the same time, achieve better levels of fit and comfort for its prosthetic and orthotic products. ■

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[SiemensMTBUMarCom.sea@siemens.com](mailto:SiemensMTBUMarCom.sea@siemens.com)