# PROSTHESIS MATERIAL

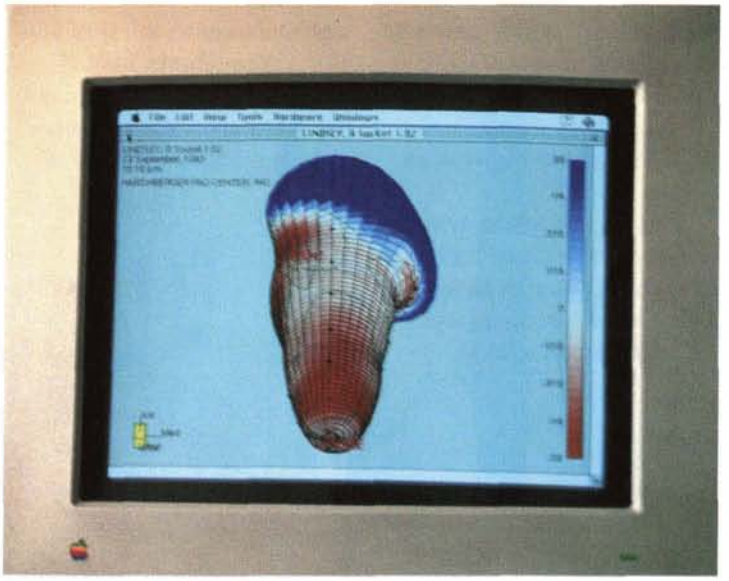
The Harshberger Prosthetic & Orthotic Center, Inc., Birmingham, Alabama offers personalized care to the injured, including crafting and fitting orthopedic appliances such as artificial limbs. The Center has a subsidiary company, also located in Birmingham, called FAB/CAM, which fabricates prosthetic components using computer-aided design and manufacturing (CAD/CAM) techniques.

Certified Prosthetist Jerald J. Harshberger, who heads the Center and the FAB/CAM subsidiary, learned of Marshall Space Flight Center's (MSFC) problem solving assistance to industry and paid a visit to MSFC. He outlined the problem: there was need to replace the plaster and corn starch materials FAB/CAM was using to produce master molds for prosthetic devices; the plaster molds were heavy, fragile, difficult to ship and store, and unrepairable if damaged.

MSFC's Technology Utilization Office provided a tentative solution. MSFC, in cooperation with Martin Marietta Manned Space Systems, New Orleans, Louisiana, manufacturer of the Space Shuttle External Tank (ET), was in process of creating a commercial derivative of the foam insulation system used to protect the ET from excessive heat. Some of the properties of the foam that made it effective as an ET insulator offered attractive commercial potential; the material was lighter, less expensive, stronger at high temperatures, more readily machinable and more stable than earlier foam insulators.

Martin Marietta was asked to produce a trial quantity of foam blanks for testing in a carving machine at FAB/CAM. The carver uses the blank for cutting a mold of a patient's residual limb; the mold is then used to form the socket for an artificial limb. The new material proved to be the solution to the problem.

Says Jerald Harshberger: "These foam blanks provided us with an alternative substitute in replacing plaster blanks. NASA foam is lighter, less expensive and faster to manufacture. Through NASA assistance, we were able to lower the cost and time of manufacturing, which financially helps our company and



our patients. We are also able to mass produce the foam blanks and distribute them to other prosthetists across the nation."

**At far left,** a FAB/CAM prosthetist is taking an impression of a patient's residual limb. The digitizer of the CAD/CAM system "reads" the inner surface of the impression **(above opposite)** and the data is entered into the computer. The computer constructs a three-dimensional image of the appropriate socket **(bottom opposite)** and the prosthetist then modifies, designs and sculpts the socket shape on the computer's monitor. The foam blank is inserted in the computer-directed carver **(left below)** which carves a positive model. A socket is then "thermoformed" over the model and the patient is ready to be fitted.

This spinoff from Space Shuttle technology represents a dual technology transfer, because in addition to the benefit to the medical community it also provided Martin Marietta Manned Space Systems with a product that has commercial potential in high temperature insulation and structural applications as well as in prosthetic appliance manufacture. Martin Marietta is producing and marketing the foam system, initially for the prosthesis market, under the trade name MARCORE™. In

the **top photo,** a Martin Marietta technician is preparing an above-the-knee foam blank; **Above,** an amputee golfer models an artificial limb made with the MARCORE material.

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