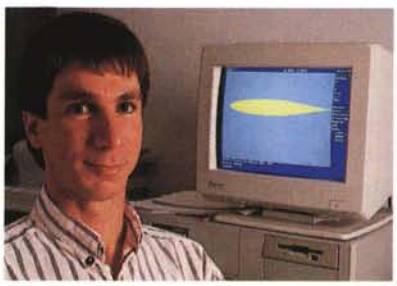
Sailboard Fin Design

In the latter 1980s, the popular sport of boardsailing moved into high performance sailing, with speeds approaching 40 knots. Such speed became possible with the introduction of a new type of hull called the "short board" and new high aspect ratio sails, which feature higher lift with less drag.

The sail's lift force is exerted laterally, or sideways. To offset that force, short board hulls employ a vertical fin or "skeg" near the stern; its job is to maintain equilibrium by generating sufficient underwater horizontal lift to balance the sail's lateral lift.



The higher performance of short boards places greater performance demands on the skeg, and that often creates a problem known as "spinout." This phenomenon occurs when the skeg suddenly loses horizontal lift, which creates a force imbalance and causes the tail of the board to slide sideways.

Windsurfing enthusiast Richard A. Caldwell, now president of RACE Technology, Inc., Melbourne, Florida, sought a solution to the spinout problem, found one in NASA technology, designed a new type of fin and formed a business on the basis of it.

In 1986, after graduating from Florida Institute of Technology, Caldwell (**above**) pursued a Master of Science degree in aeronautical engineering. He joined the Joint Institute for the Advancement of Flight Sciences program, a graduate program co-sponsored by George Washington University, Washington, D.C. and Langley Research Center. Interested in airfoil design, he proposed — and got approval for — a research project involving adaptation of NASA airfoil technology to solution of the spinout problem that plagued boardsailors.

Caldwell first determined that spinout resulted from air ventilating down the low pressure side of the underwater fin. Researching NASA technical papers, he found that a similar problem with seaplane airfoils was caused by air "separation," in which the laminar (smooth) flow of air over a wing is disrupted and the airflow breaks away, or separates from the surface of the wing; this causes loss of lift. He concluded that ventilation was creating separation "bubbles", interrupting the smooth flow of water around the fin, hence the loss of lift.

Caldwell drew on other NASA technology for the solution to the spinout prob-

lem, notably a computer program developed at Langley Research Center that models the airflow required for a low drag airfoil: the airflow must be kept laminar and free of bubbles over most of the wing's fore-aft dimension to decrease unwanted drag. Since the sailboard fin is a close cousin to the airfoil, he adapted the technology to the design of a short board skeg that would not only overcome the ventilation problem and provide spinout resistance, but would offer a bonus in low drag — meaning improved sailboard performance. He designed a foil section, known as the RACE 145, specifically for the sailboard fin; subsequent tests confirmed its low drag, spinout resistance characteristics.

NASA AIRFOIL TECHNOLOGY PROVIDED THE ANSWER TO A MAJOR BOARDSAILING PROBLEM

Upon graduation, Caldwell patented his method of designing low drag, ventilation resistant foil sections and formed RACE Technology, Inc. to manufacture sailboard fins and other sailing products.

Later, looking for further improvements, Caldwell turned again to technology developed at Langley Research Center relative to low drag wings called "sheared elliptic planforms," which offered further drag reduction. This technology, too, was adapted to the sailboard skeg.

The RACE 145 foil section is now in production in several models for different types of sailboards; four representative skegs are shown in the photo **at left**. The patented foil design coupled with the sheared elliptic planform offers a very low drag fin with spinout resistance and greater maneuverability than conventional fins. This was confirmed in a 1991 speed trial on the Columbia River in Oregon, when a sailor using a Caldwell fin design was timed at 49 miles per hour in a 35-40 mile per hour wind.

Shown **above** is the newest product developed by RACE Technology, Inc., a rigid sail for windsurfing that once again incorporates the NASA technology. Unusual for windsurfing sails, the rigid design employs carbon fiber reinforcement in its structural components for reduced weight and improved strength; it weighs only 20 pounds, about the same as the lightest conventional mast/sail combinations available. Wind tunnel tests have confirmed excellent performance for the rigid sail. ●