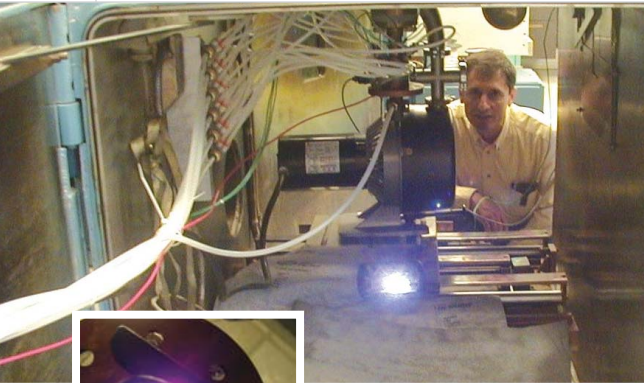


## Plasma Window Reinvents Electron Beam Welding

*Eliminating downstream vacuum chamber improves weld quality and performance; brings energy efficiency and floor-space savings.*



**Ady Hershcovitch, a physicist at Brookhaven National Laboratory, observes the firing of the plasma arc.**

**C**ONSIDERING ELECTRON beam welding? Get ready to evaluate a process innovation designed to deliver high quality without dependence on a vacuum chamber. (As with traditional electron beam methods, the new approach uses a hard vacuum at the beam source, but the difference lies in eliminating the vacuum chamber downstream.)

A plasma window is the innovation. It protects the integrity of the electron beam from the degrading effects of the atmosphere, explains concept originator Ady Hershcovitch, a physicist at Brookhaven National Laboratory, Upton, N.Y.

The plasma, a collection

of charged particles at high temperatures, is confined by electric and magnetic fields. The plasma density is low enough to be essentially transparent to an electron beam but dense and hot enough to contain a high vacuum, explains Rory Montano, president, Acceleron Inc., East Granby, Conn. (Acceleron and Brookhaven are co-developing commercial equipment.)

In addition to being a transparent barrier or window between high and low pressure regions, the plasma also sharpens the focus of the electrons. Montano explains that an electric current within the plasma window creates the lens effect. The result is that electrons exiting the plasma window can theoretically have a spot size equal to or smaller than that generated by welding within a vacuum chamber.

The electron beam travels only a few centimeters to a part after passing through the plasma window. That's not far enough to degrade the beam.

Process benefits cascade

from eliminating the need for welding within a vacuum chamber. Part size is no longer restricted, chamber pump-downs are eliminated, and floor space savings can reach 90%.

Montano claims spectacular energy and performance benefits. "Not only will the total energy conversion be 80% to 90% more efficient, but users will have the option of narrow and deep welds."

In addition, eliminating vacuum chambers translates into no pump-down delays. Montano estimates a 12-minute savings per large part for a chamber measuring 108-by-56-by-56 inches.

Electron beam welds have a reputation for both strength and aesthetic appearance. Montano predicts that the efficiencies offered by the plasma window could make electron beam welding more useful across a broader scope of applications.

"These can include welding thick structures common to ships and aerospace."