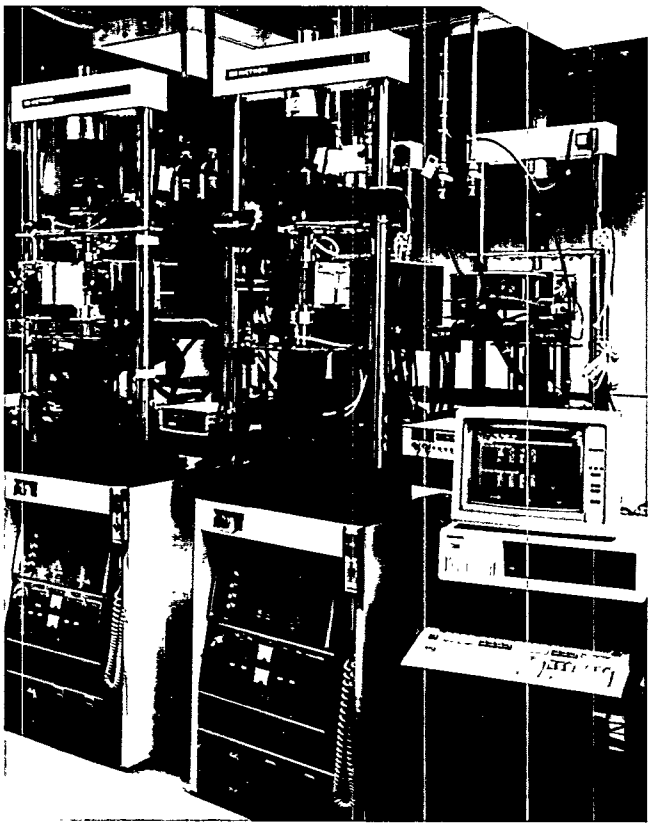
Tensile Testing System for Ceramics

A major thrust of the Advanced Materials Development Program has been to produce uniaxial tension test data on structural ceramics to be used in advanced engines. For tension testing data to be useful to engine designers, the testing system must be able to apply pure uniaxial loads to the test piece, but the high modulus and brittle nature of ceramics make this very difficult. Many past attempts had limited success or were abandoned because of the high cost of performing the test or the questionable results obtained.

Under this program, DOE developed a high-temperature ceramic tensile test device with self-aligning grips. The device uses a hydraulic flexible coupling that will not transmit bending moments and is completely self-aligning during a test, thus achieving the required alignment on most testing machines.



This high-temperature tensile test device with self-aligning grips produces uniaxial tension test data on structural ceramics to be used in advanced engines.

This testing methodology and the data generated will be critical to the designers of future advanced engines.

The technology has been licensed to USA Instron and is being marketed as the "Super Grip System." To date, more than 70 systems have been sold worldwide.

Alumina-based Ceramic Composite

DOE has supported basic materials science research focused on developing high-strength, high-temperature materials for use in automotive and light-truck engines. During the past six years, research has concentrated on alumina-based ceramic composite materials. But, as is often the case with basic research, successful results occurred in unanticipated areas.

In this case, significant advancements in machine tool technology resulted from the alumina-based ceramics research. Although the composites developed possess many of the attributes required for automotive applications, they do not yet have sufficient high-temperature resistance.

Although not yet fully developed for automotive applications, alumina-based ceramics have been marketed for use in cutting tools and have potential applications for manufacturers of various products subject to mechanical wear. Cutting tools and machine tools and dies that use this material demonstrate increased strength and improved performance compared with conventional machine tool technology.

Oak Ridge National Laboratory began an aggressive technology transfer program to disseminate alumina ceramic composite technology; ten U.S. companies have already become whisker ceramic licensees. Oak Ridge estimates that the cutting tool industries represent a $500 million market and that licensing agreements can be reached with 80% of the firms in those industries. The benefits of this product will include substantial energy savings because of increased productivity, reduced weight, and reduced levels of friction.

Ceramic Rotors for Turbochargers and Turbines

Turbocharged automotive engines have long been recognized as offering significant advantages over naturally aspirated engines. These advantages