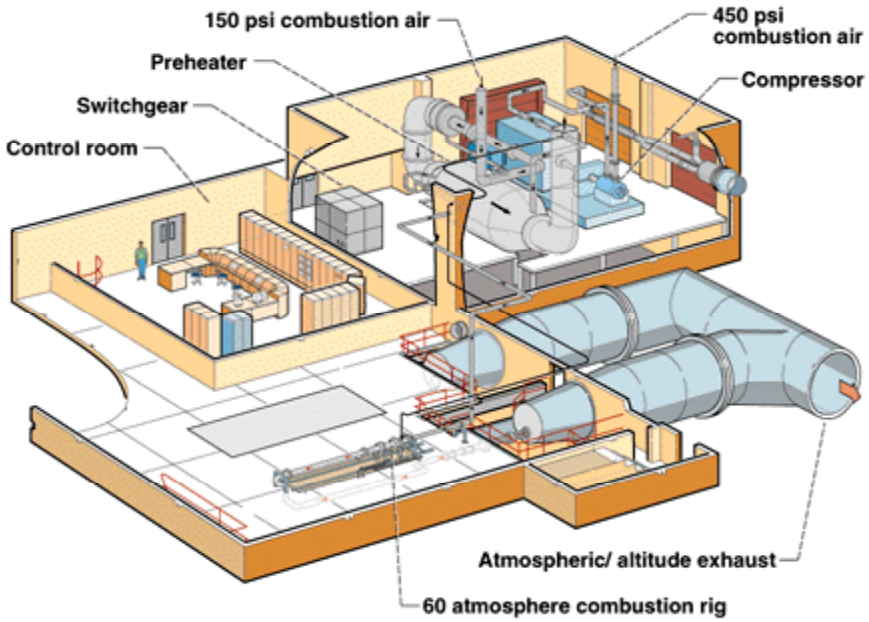
Capabilities Enhanced for Researching the Reduction of Emissions in Future Aircraft

Future aircraft jet engines will run at higher pressures to obtain greater fuel efficiency and performance. This will require new combustor designs to keep the nitrogen oxide and carbon monoxide emissions at environmentally acceptable levels.

The actual pressures and temperatures found in gas turbine combustors must be duplicated in a laboratory to verify the emissions characteristics of gas turbine engines. Recognizing this, the U.S. aircraft gas turbine industry identified a need for a national facility that could duplicate the severe inlet conditions of future combustors.

Because of our expertise in combustion emissions reduction research and in the design and operation of high-pressure test facilities, the NASA Lewis Research Center was seen as the natural location for such a facility. As a national laboratory, Lewis could provide these facilities to all U.S. gas turbine engine manufacturers while protecting their proprietary interests.

Called the Advanced Subsonic Combustion Rig (see figure), the facility will provide up to 60-atm pressures at inlet temperatures up to 1300 °F and air flow rates up to 38 lb/sec. Furthermore, it will offer state-of-the-art diagnostic methods for characterizing advanced combustor concepts.



The Advanced Subsonic Combustor Rig will provide actual gas turbine combustor inlet temperatures and pressures for future emissions reduction research.

Aeronautical combustion research at Lewis provided several significant accomplishments recently in support of both the High Speed Research (HSR) and Advanced Subsonic Technology (AST) programs. For example, in the High Speed Research Program, NO_x reductions of up to 90 percent were achieved in prototype combustor hardware. Advanced computational analysis, gas sampling, and laser diagnostic techniques were critical to this success.

Working closely with the gas turbine industry, we have successfully transferred this low-emissions combustor technology into engine prototype hardware. This hardware is now being tested at the engine manufacturer's facilities. Complementary tests in Lewis currently available 30-atm test facilities are also underway, taking advantage of Lewis unique diagnostic capabilities. By utilizing test facilities belonging to both NASA and its industry partners, we have tested multiple combustor concepts in a shorter period of time.

Having screened these concepts in the 30-atm facilities (which simulate aircraft cruise conditions), the most promising concepts will undergo further testing at actual takeoff and advanced cycle cruise conditions in the new 60-atm rig. This new facility was ready in the fall of 1995.