Facility Factsheet

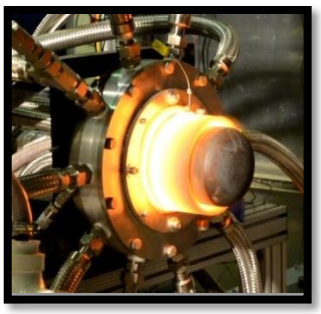
Detonation Engine Research Facility (DERF)

Description:

This facility is configured to safely conduct experimental pressure-gain combustion research. The DERF is capable of supporting up to 60,000 lbf thrust experiments, with integrated remote control and instrumentation systems. It simultaneously supports multiple active research projects with multiple thrust stands which range from 3 to 1,000+ lbf. A hardened remote-control room is adjacent to the 750,000+ cu.ft. test cell. Control of all detonation engine operations and data acquisition is done via a computer-based interface integrated into a 'virtual instrument/control system' with back-up manual shutdown and safety systems.

The facility control system is extremely flexible and can control all aspects of detonation engine operation including: air flows, gaseous and liquid fuel flows, water flows, ignition systems, programmed timing sequences, and automatic shutdown in the event of a critical system failure. In addition to conventional data acquisition and control systems, the facility is equipped with high-frequency data acquisition at up to 5 MHz. Up to 1.4 MHz framing rate digital imaging is also available for advanced laser diagnostics and imaging techniques. Detonation research engines are used for performance validation and as a test-bed for research of detonation initiation, fuel injection (including endothermic/regenerative fuel cooling), valves, controls, materials, heat transfer/thermal management, nozzles, ejectors, hybrid turbine engines, acoustics, power extraction, emissions, and diagnostics. A single shot impulse pendulum is available for precise thrust measurements as well as a detonation shock tube for high pressure/temperature initial conditions.

Up to 6 pps of airflow is available continuously at up to 100 psig and 40,000 pounds of high pressure, high flow (up to 2200 psi/30+ pps) air available for shorter durations. Oxygen and nitrous oxide are approved as alternative oxidizers. For self-aspirated engines, 200+ pps air intake is available with supporting ambient exhaust (14.3 psia). A small-scale steam ejector system provides vacuum capability to 3 psia for low flow rates. Vapor and liquid fuel systems encompass nearly every fuel utilized for air-breathing propulsion (from hydrogen to advanced bio-fuels) with direct connection to the liquid fuel farm for larger flow rates. The facility drainage is isolated with a fuel segregator, and a three-zone Cardox system provide environmental protection along with gas monitoring for fuels, CO and NOx.



Purpose:

The primary object of the facility is the research and development of pressure-gain combustion including rotating detonation engines (RDEs) and pulsed detonation engines (PDEs). The in-house PDE program with the DERF was established in order to make AFRL's unique resources available for the development of this technology. Recent focus has shifted to RDE development for aerospace applications. In order to work with pulsed and rotating detonation phenomena, AFRL has set out to develop the facilities, diagnostics, modeling tools, and experience necessary to contribute and provide unique resources for the maturation of pressure-gain combustion technology.

Products:

PDE and PDE hybrid performance 4-tube research PDE that has been operated with over 20 different fuels and hundreds of detonation tube geometries. Other pressure gain combustion devices include pulsejets, single and multi-tube PDE's, and a 7-tube rotary valved PDE. RDEs have been operated on a wide range of both liquid and gaseous fuels, over a wide range of scales, and for long durations. Component technology products include: aircraft structural/acoustic interaction validation, unsteady ejector/nozzle technology, endothermic/regenerative fuel cooling, detonation initiation and transition technology as well as small-scale internal combustion and turbine engine research.

Availability:

Primarily in-house and related DoD contractor research. Other U.S. Government agency, DoD contractor and commercial customer programs upon request. Contact: 937-255-4100.